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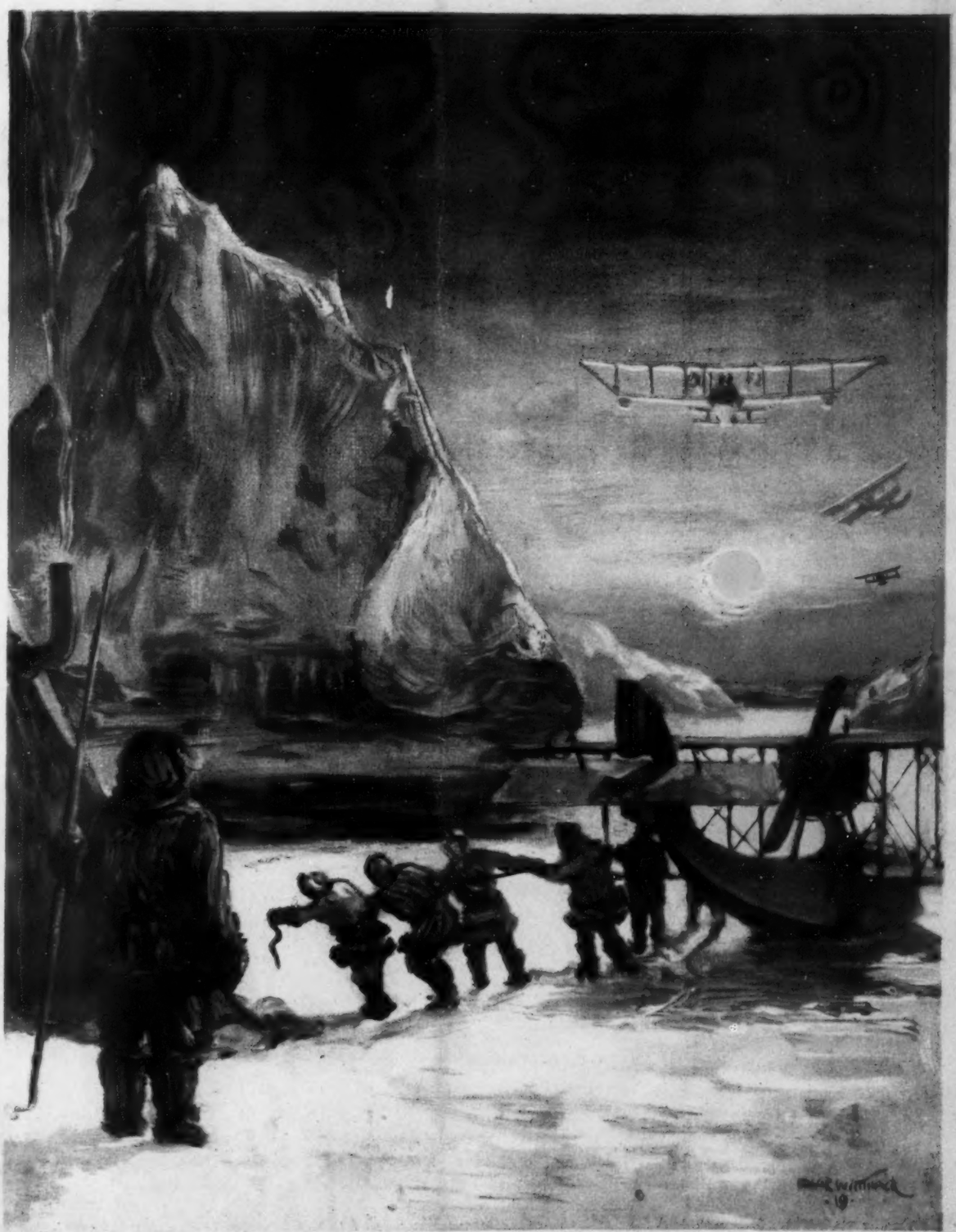

EXPLORING THE FRIGID POLAR REGIONS WITH THE AID OF THE AIRPLANE

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February 1, 1919

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THE

CROIX de GUERRE

has been awarded the First and Second Groupements of the Great Headquarters Reserve No. 1 of the French Army, each operating 500 or more White Trucks. Citations for distinguished service accompanied the order, supplemented by a later citation to the entire Reserve No. 1, operating

2,500 WHITE TRUCKS

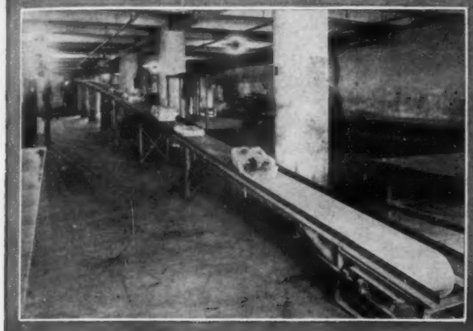
This is the first and only instance on record of motor transport formations in *any* army receiving this high honor.

The White Trucks were all veterans, many in continuous war service since 1914.

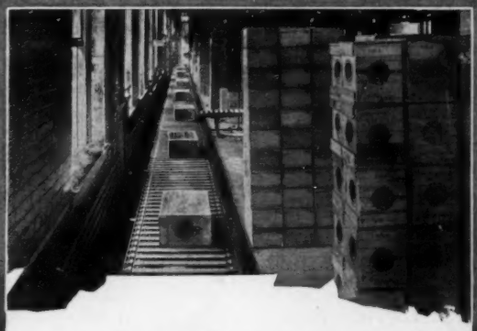
"White Trucks Have the Stamina"

THE WHITE COMPANY
CLEVELAND

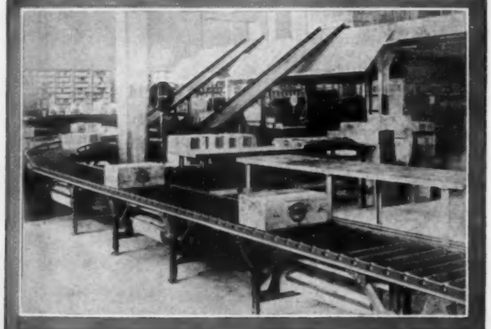
A CITY of Gravity-ized PLANTS



Conveying bundles of newspapers on Standard Belt Conveyor.



Standard Car-Loading Conveying System.



Portion of Indoor Transportation System.

GRAVITY, under the control and guidance of *Standard conveyors*, is serving every line of industry.

If these plants and their employes were located in one place, they would make a city larger than Chicago and surrounding suburbs. The small as well as the million dollar plants have found *Gravity* indispensable in the handling of merchandise, materials, and in the indoor transportation of practically *every class of commodity*.

There is a *Standard System* or unit of *conveyors* that will *revolutionize* your former methods, *greatly reduce* expense of handling, *speed up* production, *increase* capacity, and in innumerable ways add to the *pleasure* and *profit* of doing business.

Our representative in your city or vicinity is your conveying efficiency man—*make use of his services.*

From the car to the pile on Standard Lumber Conveyor.

Conveying castings to and from machine operators on Standard Roller Conveyor.

Standard Gravity Spiral Chute lowering general merchandise.

STANDARD CONVEYOR CO.

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New Test of Transportation Efficiency for Packard Owners Starts February 1st

Test Covers One Year's Operation—Drivers, Accountants and Shipping Clerks to Share in Cash Prizes of $17,640.00

How much work can a motor truck deliver? What ought to be the cost of doing the work?

THESE are two of the most pressing questions in American business today—what with the railroad congestion and the need to save freight cars; with the staggering quantity of merchandise to be moved; and with the great business expansions already taking shape.

Motor truck efficiency means not only gasoline economy, tire and oil saving, and repair economy.

It means also the right size truck for your average load; efficient routeing; saving of time in loading and unloading; the way the truck is handled all along the line.

It means *standardizing costs*—every item fixed and known.

Basic principles, all of them—and the purpose of this new National Truck Efficiency Test is to show the Packard owner how these basic principles can be applied to his *individual business.*

The test covers one year's operation—demonstrating what can be done under all conditions of weather, temperature, road and load.

The Packard owner may enter as many of his Trucks as he wishes.

Prizes are not only awarded to the *Driver,* for keeping his cost down in relation to his service; but to the *Accountant,* who tabulates the records; and to the *Shipping Clerk,* because much of truck efficiency depends on efficient work at the shipping platform.

How to Enter Your Trucks in the Packard National Truck Efficiency Test

Your local Packard Branch or Packard Dealer will accept your entries and see that your Packard Truck or Trucks are formally enrolled on the Official List of Contestants.

THE Test starts on February 1st, 1919, and continues to January 31st, 1920.

Trucks are divided into seven *Divisions,* according to size:

"A"	Division—all	*6-ton* Trucks
"B"	" "	*5-ton* "
"C"	" "	*4-ton* "
"D"	" "	*3-ton* "
"E"	" "	*2-ton* "
"F"	" "	*1½-ton* "
"G"	" "	*1-ton* "

The Grand Total of Prizes is $17,640.00—including five prizes for *Drivers, Accountants* and *Shipping Clerks* in each *Division*—as follows:

PRIZES	*Drivers*	*Accountants*	*Shipping Clerks*
1st	$500	$125	$225
2nd	400	100	175
3rd	300	75	125
4th	200	50	80
5th	100	25	40

Contestants shall be Packard Trucks only.

All costs and operating shall be kept and submitted on the standard forms of the National Standard Truck Cost System, which can be obtained through your Packard Branch or Packard Dealer.

Recapitulation of operating and cost data must be submitted monthly by owner to the Packard Factory for inspection and correction.

A Packard Truck of *any size* can compete on a fair basis. Trucks are classified according to capacity into *Divisions.*

Here is where the owner will learn whether his truck is just the right size for his work—or *too large,* power lost by running on underload—or *too small,* necessitating overload to get his hauling done.

* * *

The Packard owner starts the test with the basic principles developed by the Packard Organization of transportation specialists.

He has a year to apply these principles to his individual business.

What can he not achieve in efficiency!

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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NUMBER 5

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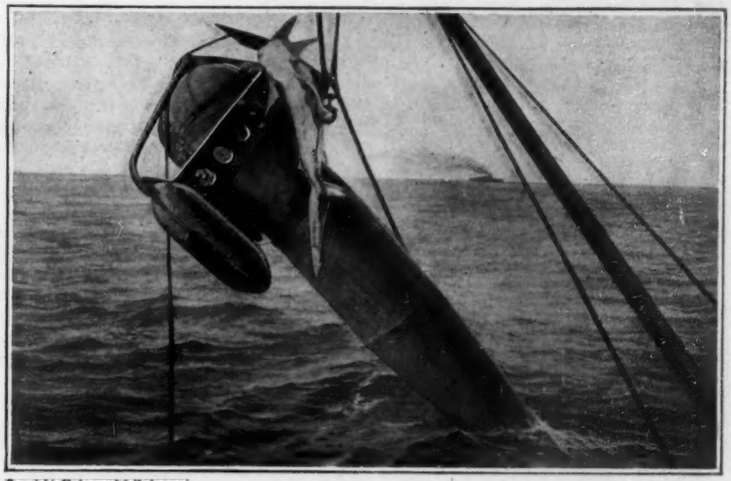
Paravane hauled out of the water, showing the hinged cutting jaw, plane member, rudders, and floats



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This paravane caught a small shark instead of a deadly mine in its cutting jaw

The Paravane—A Steel Shark Which Protects Vessels in Mine-Infested Waters

THE naval mine is a far more treacherous weapon than the torpedo. It gives no warning of its presence as it swings some distance below the surface, ready to strike a crushing blow the moment it is touched by a ship. In the great war the mine has accounted for many ships, among them the British dreadnaught "Audacious" and the American cruiser "San Diego," the latter having been sunk off the coast of Long Island. Indeed, the Germans, fully realizing the effectiveness of the naval mine, sent large numbers of mine-laying submarines into enemy waters with the object of sowing mines at the entrance of harbors and in the well-known shipping lanes.

But whatever may have been the destructive qualities of the mine as compared with the torpedo, its actual effectiveness has been largely curtailed by the introduction of a protective device for vessels crossing mine-infested waters. This device is known as the paravane, and it is reported to have been instrumental in making the German mine fields more or less impotent against Allied vessels.

Briefly described, the paravane may be said to comprise a hollow torpedo-shaped body, a plane member terminating in two floats, horizontal and vertical rudders forming the tail, and a cable-cutting jaw. In operation the paravane is towed by the ship which it is to protect. As will be noted in the accompanying sketch, a paravane is towed on either side of a ship by means of a single cable leading back from the bow. The point of attachment to the bow is about ten feet below the surface, and each paravane maintains a parallel course about twenty-five feet away from the ship's side. As they are being towed at a depth of about ten feet, the paravanes can be plainly seen from the deck of the ship, having much the appearance of sharks.

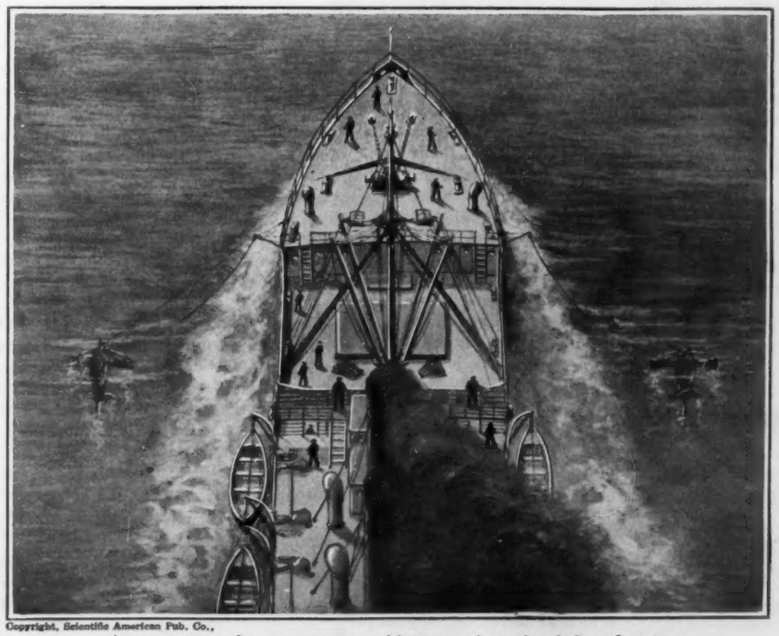
The plane member and the rudders of the paravane, as well as the position of the towing cable, maintain this device at the proper depth and hold it to the parallel course. Aside from the towing cable, there is another cable connecting the paravane with a small boom or davit on the fo'c'stle. The purpose of this cable is to haul in the paravane, as well as to operate the cutting jaw in the more recent models. The hauling cable is pulled taut, while the other cable is practically free from strain except when it is working the cutting jaw.

Given two paravanes and two taut cables which form a V-shaped fender at the bow of a ship, it is a simple matter to understand what happens when such a combination enters a mine field. The mines, which are anchored to the sea bottom by means of steel cables, are taken care of as depicted in the sketch. The paravane cable nearest the mine engages with the mine cable, pushing the mine aside and causing the mine cable to slide along until it comes to the jaw of the paravane. The jaw soon cuts the mine cable, releasing the mine which then bobs up to the surface. At this point in the game the floating mine is exploded by rifle or machine-gun fire, thus ending its empty career.

In the earlier forms of paravane the cutting jaw consisted simply of a rigid wedge with saw teeth. The force with which the mine cable came into the jaw, as well as the twirling and twisting of the mine and its cable, was depended upon to cut or tear the cable. In a more recent form the second cable of the paravane extends from the jaw to a winch on board the ship. The winch is arranged to operate continuously, but allows the cable to slip each time it has been wound up tightly. Thus the cutting jaw, which is hinged in this case, is alternately opened and closed so as to act as a pair of powerful shears.

Most ships traversing mine-infested waters have been equipped with the paravane. American transports have all been equipped with the device. The "Leviathan," for instance, is understood to have carried four paravanes on each trip, two for use in mined waters and two in reserve. At the high speeds made by this giant transport much trouble has been experienced with the paravanes, and it is said that a trip was seldom made in which two or three were not lost. In fact, it is the difficulty of handling the paravanes on high-speed ships that has often tempted the crew to get along without them, although they are recognized as a reasonably sure form of mine protection. On slow vessels, however, the paravane is readily managed.

(Continued on page 108)



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Arrangement of paravanes on a ship traversing mine-infested waters

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A World in the Re-making

WITH all Europe busy in reconstruction, and the final removal of the veil of secrecy that has so enshrouded the activity of the past four years, a vast store of interesting and valuable material is to be had on the other side of the water. We have sent our well-known Washington correspondent, Mr. C. H. Claudy, to tap this reservoir for us; and his articles will feature our pages, we hope, for a long time to come. We direct the attention of our readers to his first communication, which appears in this issue.

Sublime Heroism in the Navy

THE United States Navy is held in high esteem by the American people, and its personnel, officers, and men alike, have an assured position in our regard and affection. Although these sentiments have been greatly stimulated by the fine record of the navy during the present war, they are not local or ephemeral. Pride in the navy and affection for its officers and gallant lads are as old as the nation itself. They had their birth with the birth of the Republic, and ships and men alike have served to build up, on all the seven seas, that tradition of patriotism, courage, heroism, and chivalry, which is the navy's most cherished possession.

"They had no traditions, nothing up to which they had to live," said an officer of the victorious fleet, in explaining the wholesale surrender of the German fleet.

Naval tradition—how swiftly the men and ships who made it leap to our minds! Paul Jones and the "Bonhomme Richard," Farragut and the "Hartford," Dewey and the "Olympia," Rodman and the "New York," with all the men who, on destroyer, scout and transport, faced that modern terror, the pirate submarine, in the bitter cold and furious weather of European waters.

But it is not of heroism in battle on the high seas that we wish to speak just now, but of heroism of another kind and place. We wish to offer our tribute to the brave lads of the navy, who, as mentioned in the adjoining column, deliberately courted death in the quiet of a sick ward filled with victims of that dread disease, influenza.

The psychologists tell us that heroism is a complex of many impulses and emotions, particularly when it is displayed in the heat of battle. Each of these adds its stimulus of pride, hatred, anger, desire for fame and reward, patriotism and self-sacrifice. There is also the inspiration of comradeship and the stimulating leadership of the officers. One, or several, or all of these combine to carry the men forward to heroic deeds.

But when those sailor lads in Boston and San Francisco entered the sick ward, bent over their stricken comrades, and deliberately breathed in the pestilential exhalations, they "went over the top" with just the simple motives of patriotism and self-sacrifice. Unarmed and naked, they faced a foe that had slain its millions in Europe and had killed nigh half a million of citizens of their own country.

They knew perfectly well what they were doing, for they had been told that they were courting death. For aught they knew, the great world outside of that quiet ward would never learn of their supreme sacrifice. No inspiring bugle note called to duty; no onlooking army spurred to action; no decoration was flashed before their eyes—no reward save that which comes when a man's own conscience whispers to him, "Well done."

"Greater love hath no man than this that a man lay down his life for his friends."

We suggest that the Navy Department make known the names of these hundred sailormen, who volunteered for this hazard of death. Thus will our naval tradition be enriched and their names and their sacrifice be honorably perpetuated.

The Influenza Mystery Deepens

SOME time ago in commenting on the spread of epidemic influenza, we spoke of the disease as "a disease of mystery." That this is even more true today is indicated by experiments just made public by the United States Public Health Service.

It may be recalled that medical scientists are by no means agreed as to the nature of influenza. The influenza bacillus discovered by Pfeiffer in 1892 has, it is true, been found associated in a large proportion of the cases during the present world-wide epidemic, but the best opinion looks upon this bacterium as more probably a secondary invader, and holds that the true causative micro-organism has not yet been isolated.

Some months ago, Nicolle, a well-known French bacteriologist, reported the results of a series of experiments which indicated that the virus of influenza was "ultra-microscopic," and able to pass through filters of unglazed porcelain. This announcement appeared the more credible since the investigations by Foster, an American army surgeon, had already shown that common colds are caused by a filterable virus.

Quite unexpectedly, however, Rosenau of Harvard, made public the results of experiments which he believed indicated that the virus of influenza was not filterable. He introduced into the nose and throat of a number of volunteers filtered secretions from active cases of influenza and failed to reproduce the disease. Careful examination of the protocols of Rosenau's experiments showed, however, that he had failed to test the infectivity of the unfiltered secretion.

It was to remedy these defects in the investigations that a second series of experiments was made, this time in coöperation with the Hygienic laboratory of the United States Public Health Service. In this investigation, which was carried on both in Boston and San Francisco, over one hundred men of the naval training station volunteered to submit themselves to experimental inoculations. By means of sprays and swabs filtered and unfiltered secretions from active cases of influenza were transferred to the nose and throat of the volunteers. In addition to this pure cultures of Pfeiffer bacilli were similarly introduced; for, after all, it was still important to know whether this could produce typical influenza. Finally, in order to reproduce natural conditions as much as possible, a group of volunteers, brought into a ward in which were active cases of influenza, leaned over each of ten bed patients, conversed a few minutes and allowed the patients to cough into their faces.

And the result?—in not a single instance was influenza thus produced in any of the volunteers!

It is, of course, possible, that in influenza the virus is present in the nasal secretions for only a limited period. This is the case, for example, in measles. In yellow fever, too, we know that the virus exists in the blood for only a few days, so that search made before and after that period invariably yields negative results.

By analogy, there is still every reason to believe that influenza is most commonly spread by droplet infection, *i. e.*, by close contact with influenza patients who cough, sneeze and spit. This, too, is the view of Surgeon-General Blue, who warns against a misinterpretation of the experiments just cited. More than ever, therefore, influenza is to be regarded as the disease of mystery.

Round Pegs and Square Holes

PERHAPS in no field of science has the war stimulated such sudden and such notable advances as in that of the psychologist. He has had unprecedented opportunity to observe the behavior of men under conditions of stress; and he has been called upon to make tests, and perforce to devise machines and methods of test, on a scale never before contemplated. He has proved his technique to himself and to others; he now stands on a level of achievement and recognition impossible of attainment in years of normal activity.

Four weeks ago we thus summarized the year's development in this science which has so newly been transferred from the realm of the inexact to the category of the exact. We then supposed that, having graduated into the class with the exact scientist, the psychologist would still have to go a long way toward overcoming popular inertia before he could show definite evidence of his acceptance as a practical scientist, an engineer. But any expectation to the contrary notwithstanding, the psychologist has just made a real advance toward that very goal. It is announced that Columbia College will, in September, abandon the old system of entrance examinations, and substitute psychological tests to determine the students' mental capacity.

As in the past, the candidate for admission will be required to exhibit his school record. Instead of proceeding on the theory that this certificate is open to suspicion, however, the College will accept it without more ado as evidence that the student has satisfied the academic prerequisites for college work. Having thus graded his learning, it will then proceed to grade his intelligence by means of tests of substantially the sort adopted by the Army. These tests will be interpreted in connection with the candidate's history, to determine whether or not he can profitably be asked to continue his schooling. Dean Hawkes hits the nail on the head when he says: "We expect these tests to show us whether it will be worth our while to try to educate the student, and whether it will be worth his while to have us try."

This is a radical departure, but, we believe, not too radical a one. Set examinations are not of themselves objectionable; if the student has not sufficient control over what he has learned to meet the examination with success, he has not sufficient control to meet practical situations where he is called upon to use his acquired knowledge. For this reason, we have little sympathy for the student who complains that his peculiar temperament prevents him from doing himself justice in an examination. If he can't command his learning when he needs it, what possible sense is there in his acquiring it.

It is, therefore, not at all on the ground of any objection to set examinations, as such, that we hasten to endorse the proposed change. It is rather on the ground that in passing his preparatory school courses the student has already subjected himself to a more or less severe examination, and has emerged from it with success. It has always impressed us as a tremendous waste of effort to examine him seriatim every winter and spring for three or four years, and then do it all over again in one wild week preceding his entrance to college.

It will of course be urged that the percentage of students who come up with good school records and fail to handle the entrance examinations is sufficiently large to show that this repetition *is* necessary. We believe, on the contrary, that the preparatory schools are lax in their examinations and in their awarding of certificates, because the certificate of the school that John Smith has passed his plane geometry really means nothing save that he has attended the course in plane geometry. It has this restricted meaning because the colleges refuse to allow it any other. The school can, therefore, afford to thrust upon the college the responsibility of telling the student that his school work has been badly done. If, however, the school certificate were accepted at its face value, it would be well understood that an undue number of cases where students from a particular school turn out to have inadequate preparation would result in refusal longer to recognize certificates from that school. Then the school would have to shoulder its own responsibilities; and the result would be better for the school, better for the student, better for the college.

The innovation which Columbia has adopted will further result in more intelligent selection of the student body. Under the old system, anybody who can be crammed with enough facts to get by the examiners gets into college; he may not stay long, but he gets in. The fact is that while a certain specific preparation is necessary before a student can attend college profitably—just as we must build the anchorage before we can erect the bridge—it is by no means the most important factor.

What should constitute the determining factor in admitting students to college is precisely those qualities of general intelligence and maturity of mind whose presence or absence is revealed by the psychological test. This test is, therefore, more significant than the old one. Columbia has done well in bringing about this innovation.

Naval and Military

Sixteen Inch vs. Eighteen-Inch Guns.—The removal of the 18-inch guns from the British cruiser "Furious," because their discharge stressed the ship's structure too heavily, suggests that our 16-inch fifty-caliber gun is about the limit of weight and power for naval ordnance. Our gun weighs 128 tons and its shell 2,100 pounds; the shell of the 18-inch gun must have weighed some 3,000 pounds and the gun nearly 200 tons.

The Submarine is Blind and Slow.—In spite of the fact that the British have some steam-driven, 2,700-ton submarines, capable of a surface speed of from 23 to 25 knots, the submarine, as a weapon of war, is too slow and too blind when it is submerged to be considered a serious weapon of naval warfare. When it can see, electrically, to a distance of 10 to 15 miles, while it is submerged so deeply as to be invisible to the airscout, and when it can steam 20 knots submerged, it will dominate the naval situation.

Tank Used for Hauling Barges.—The French have recently made an interesting demonstration of the availability of the tank for water transportation. On a recent occasion, one of these former engines of destruction was put to work on the Marne Canal near Epernay by the Ministry of Public Works. The tank hauled a large convoy of barges at a speed of nearly two miles an hour, which is double the speed that could have been made with the same load hauled by horses or mules.

How the Australians Bagged an 11-inch Gun.—Describing how a German 11-inch railroad gun was captured by Queensland infantry, *Flight* has the following to say: "The Queensland infantry saw a train apparently trying to get off one line and onto another to escape. In the center of the train was a great sheeted object. A British plane dropped a bomb near the engine, which apparently damaged it, for a large cloud of steam went up, and the crew, who were afterwards captured, were terribly scalded. The plane then dropped a bomb on the tail of the train, which blew up. An Australian engineer got up steam, unhooked the tail of the train, and shunted the gun through to our lines."

U. S. Shipping Board Tests Electric Welding of Ships.—After exhaustively investigating electrical welding, the Electrical Welding Committee of the United States Shipping Board, Emergency Fleet Corporation, is so well satisfied as to the practicability of this process, that it formally urged that a 9,300-deadweight-ton ship be built by electrical welding. This recommendation has not as yet been approved, because of the general sentiment among the body of experts that a smaller ship should be first constructed. Meanwhile, there is about to be built for demonstration purposes at the yard of the Federal Shipbuilding Corporation at Kearney, N. J., a 42-foot electrically welded midship section of a 9,600 ton ship. The methods of assembling and welding to be used on this section are due to A. J. Mason, Consulting Engineer for the United States Shipping Board and member of the Electric Welding Committee.

The "Eagle" Boats.—The Ford "Eagle" boats, of which we are hearing so much just now, were designed for anti-submarine service—work for which we have always considered them to be too small. Line officers would have preferred a larger craft, and we believe that if our naval constructors had had their way and been left entirely free in the matter, they also would have designed a larger boat with better sea keeping qualities. How far Mr. Ford had to do with the design we do not know, but we do know that speed of construction was a controlling consideration. Hence the framing and the general lines of the ships were drawn so as to reduce bending and general working to a minimum. As a result the boats have straight wedge bows, with practically none of that flare which characterizes all modern war vessels. Consequently, they would be in trouble driving into a head sea or running before a following sea, in which latter case they would be very difficult to steer. Either the construction of any more of these boats should be abandoned, or the design should be modified to give them better sea-keeping qualities. Testimony was recently given before the House Naval Committee that 112 were ordered, that 7 have been practically completed and that 5 are ready for commission. The contracts for 40 or more have been cancelled. The contract price for hulls and engines was $275.00; they have cost $400.00.

Science

Negroes in the United States.—The last annual report of the Director of the Census announces the completion, in readiness for publication at an early date, of a compilation, in one volume, of all the census statistics pertaining to the negro race that have been collected in this country from 1790 to the present time. This report includes, in addition to data from the decennial reports, annual mortality statistics relating to negroes for the years 1900 to 1915.

Earthquakes in 1918.—The official report of the Georgetown University Seismological Station, Washington, D. C., shows that during the year 1918 there were recorded on the seismographs 98 earthquakes. From dispatches received the location of 37 quakes of importance was ascertained. Of these, three were disastrous, the first occurring in Guatemala, the second in China and the third in Porto Rico. No disturbance of any consequence is tabulated as having taken place in the United States.

Egg Substitutes.—The U. S. Bureau of Chemistry has recently turned its attention to the numerous so-called "egg substitutes" now on the market, concerning some of which extravagant claims are made on their labels, as to their food value and their ability to serve the purpose of eggs in baking and cooking. Analyses show that many of these substitutes consist essentially of a mixture of starch and baking powder, colored yellow with a coal-tar dye. A few contain casein, which is an ingredient of milk. The food value of such preparations, says the Bureau, is far inferior to that of eggs, and experiments show that the substitutes do not have the effect of eggs in cooking. Action has already been taken under the Food and Drugs Act to prosecute the manufacturers of some of these preparations.

The Mountaineers of Tennessee.—Some interesting studies have been made by Dr. Ales Hrdlicka, of the Smithsonian Institution, on the Tennessee mountaineers, especially as exemplified by 150 men called for examination in the first army draft. His work, commencing at Bristol, Tenn., extended to Mountain City, and farther on into the hills. His studies do not confirm the idea that these mountaineers represent a separate type of Americans. Among them are found some examples of fine physique, while others are of relatively feeble mental powers or nervous stability, perhaps due to the hereditary effects of alcoholism or other inherited defects. There are all grades of "mountaineers," and no line of demarkation separates them from the people in the lower lands, who are mostly of similar derivation. Many mountaineer families are remarkable for their size. One man of 83 was the father of 21 children, ranging down to three or four years old. The draft, says Dr. Hrdlicka, should prove a God-send to many of the young men, many of whom are illiterate, and whose worst enemies are isolation, "moonshine" whiskey, and, in many cases, poor heredity.

Vital Statistics in the United States.—From year to year the SCIENTIFIC AMERICAN has recorded the steady, though far too slow, approach which this country has been making to a place in the ranks of those nations which possess such a system of collecting vital statistics as may reasonably be demanded of a civilized people. According to the recent annual report of the Census Bureau for the past fiscal year, the "registration area" for death statistics has now grown until it embraces 28 states, the territory of Hawaii, the District of Columbia, and 42 cities in non-registration states. Thus it contains approximately 73 per cent of the total population of the country. The most recent additions were the state of Tennessee and the territory of Hawaii, admitted for 1917, and the State of Oregon, admitted for 1918. The inclusion of Hawaii extended for the first time beyond the limits of continental United States the area for which the Census Bureau annually collects and publishes mortality statistics. No state, territory or city is admitted until a test has been made to prove that the deaths occurring therein are properly recorded under state law or municipal ordinance, and that the registration is at least 90 per cent complete. The Federal collection of birth statistics began in 1915, with a registration area comprising ten states and the District of Columbia and about 31 per cent of the total population. Ten states have since been added, and the area contains about 53 per cent of the country's total population.

Electricity

Fixation of Nitrogen in Japan.—According to the *London Electrician*, the Japanese Government has decided to establish a laboratory for the study of questions relating to the fixation of atmospheric nitrogen. Hitherto 20,000,000 yens' worth of ammonia for fertilizers has been imported, and it is hoped to make Japan independent of foreign supplies.

Again: The Renewable Fuse Plug.—The latest renewable fuse plug to be placed on the market appears to be about as simple as could be desired. It consists of only three parts: A one-piece porcelain body with outside thread to fit the cutout; a fuse strip of the desired capacity, and a mica disk cover. The fuse strip can be inserted in a few moments. It is pushed through a slot alongside the middle of the bottom, pulled up inside and bent through a slot near the top and over to the outside, being fastened in a little pocket at the bottom of the thread; the other end is bent over the bottom button, thus forming the end contact, then pushed through another slot on the opposite side of the button, and bent over inside to prevent the end falling out when the fuse blows. After the mica is replaced, the plug can be put back ready for use.

Solution of Flood-Lighting Problems.—The so-called flood-lighting, which has found many special applications in the United States, will no doubt become more familiar throughout the world in the no distant future. From a recent article in the *General Electric Review* it is evident that such methods are already becoming standardized, and with the data available for any particular projector, it is easy to determine the resultant illumination on an object at a given distance, or the number of projectors necessary to cover a given area. We notice that the illumination considered necessarily varies according to the surface of the building or other object illuminated and its surroundings. This, no doubt, is quite natural, as one would expect a higher illumination to be necessary in order to make an object "stand out" in a brightly lit thoroughfare than would be needed if it stands alone amidst dark surroundings.

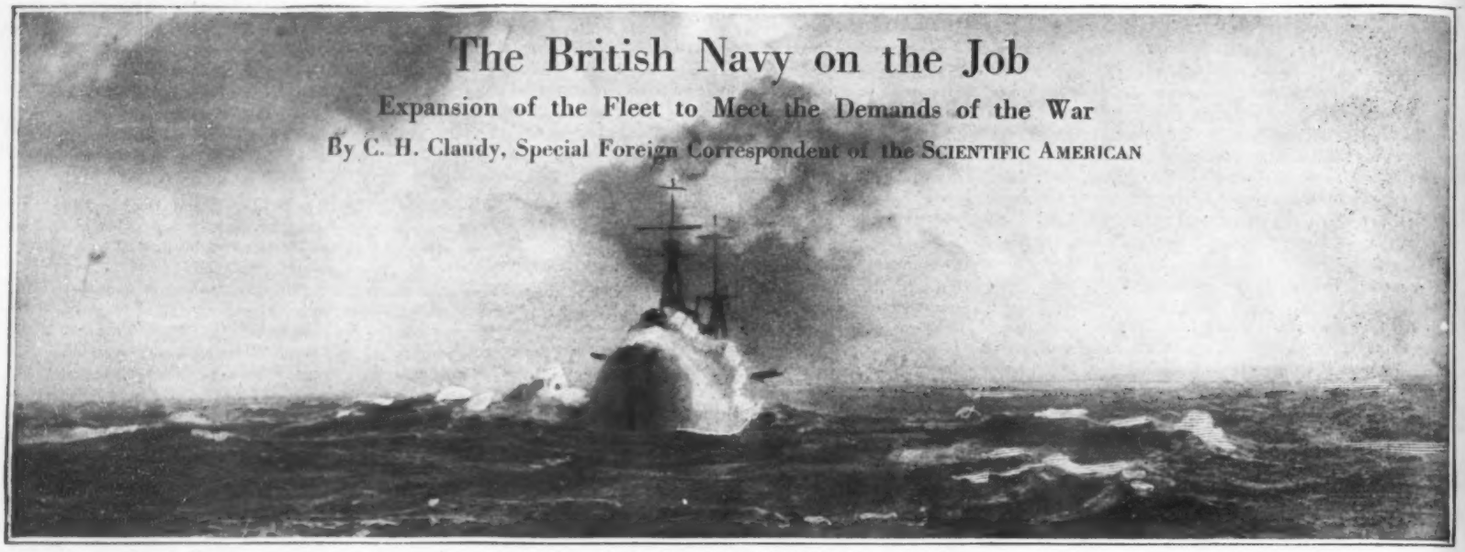
Pneumatic "Fishing" Device for Conduit Work.—In conduit work where the wires are to be enclosed in metal pipe, the joining of the conduit by no means terminates the task of the electrician. There still remains the task of passing or "fishing" the wires through the conduit, which is by no means a simple one where there are many elbows. New methods have done much to simplify this task. One of the most recent is a pneumatic "fishing" device, consisting of a hand pump, pressure tank, flexible air hose, reel for cord, and a traveler. The traveler consists of a small shaft carrying three light disks which form a more or less perfect piston with the conduit walls as the cylinder. When air pressure is applied the traveler is pneumatically impelled along the conduit whether it is straight or curved, and around all manner of bends and elbows. A cord is pulled after the traveler. When the traveler has reached the other end of the conduit, the string can be employed for pulling the wires through.

Maintenance of Accumulators in War Time.—In *Elektrotechnik und Maschinenbau* an account is recently given of some special difficulties leading to the breakdown of some cells in a buffer battery installed in the generating station of an Austrian street-railway system. The trouble was due to faulty maintenance, which is attributed to war conditions. Several cells were known to be in a bad way, but could not receive immediate attention, and ultimately one of them "blew up," shooting out long flames, which could only be put out after the battery had been disconnected. The breakdown, which was repeated shortly afterward on another cell, was due to the destruction of the plates which fell away from the upper lead frame. The level of the acid had sunk below this line of fraction, the whole supply of 600 volts being thus interrupted, an arc ensued and volatilized the lead. The author quotes this example as a warning to take care to keep the upper edge of battery plates well immersed in the electrolyte. If the story had not appeared in a technical contemporary, we should have said that such circumstances could not have arisen in a civilized country. But that raises other reflections, adds *The Electrician*, in abstracting the foregoing account.

The British Navy on the Job

Expansion of the Fleet to Meet the Demands of the War

By C. H. Claudy, Special Foreign Correspondent of the SCIENTIFIC AMERICAN



The battle-cruiser "New Zealand" driving into a head sea

THAT the British Navy had two big main tasks to perform in the war and performed them both with great honor and credit to itself and profit to all the world is generally admitted. It was Great Britain's task, as possessing the greatest fleet in history, first to sweep the German flag from the seas, and second, to so blockade the German Empire that its supplies from without had to come by tortuous ways and secret methods, rather than by ships.

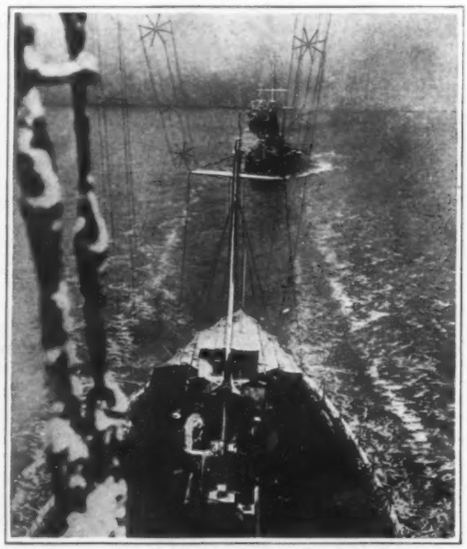
Later on, as the war developed, grew two other problems, in the solving of which the allied navies bore a somewhat larger share though by no means ever as large as that played by the British Navy. These were the submarine menace and the safe convoy of both troops, animals and munitions, and especially of troops and munitions across 3,000 miles of ocean from America.

How well the job was done every one knows. Just how it was done, few know and less will tell. It is rightly held at the British Admiralty that while perhaps little harm could be done by revealing all the story of the gigantic tasks performed by the British ships, it may well be the part of wisdom to wait for a full revelation until the concluded peace is finally a fact and not a hope.

There are, however, certain things which there is no longer any objection to spreading broadcast, and these, or some of them, were laid before me to use for the benefit of the SCIENTIFIC AMERICAN and its readers, the majority of whom will unquestionably be interested in knowing just how big the Grand Fleet is, and what was its growth during the war.

On August 3d, 1914, the personnel of the British Navy was 146,000 men. Four years later the total man power force was 406,000. These men began the war with a displacement tonnage aggregating 2,500,000 tons and, after four years sailed in bottoms which aggregated the enormous amount of 6,500,000 displacement tons, a figure which it is almost impossible to grasp. It includes, of course, all the auxiliary ships and small craft, acquired as well as built during the war and those, such as for instance the Cunarders, which were converted, according to plans made when they were built, to act as auxiliary cruisers, etc.

But the building record has been without a parallel, and perhaps nothing (unless it be the figures of accomplishment, other than battle results) can give a clearer idea of how single-mindedly Great Britain lived up to her most often heard maxim "Win the war!"



Battle-cruisers passing to their moorings after a wintry patrol

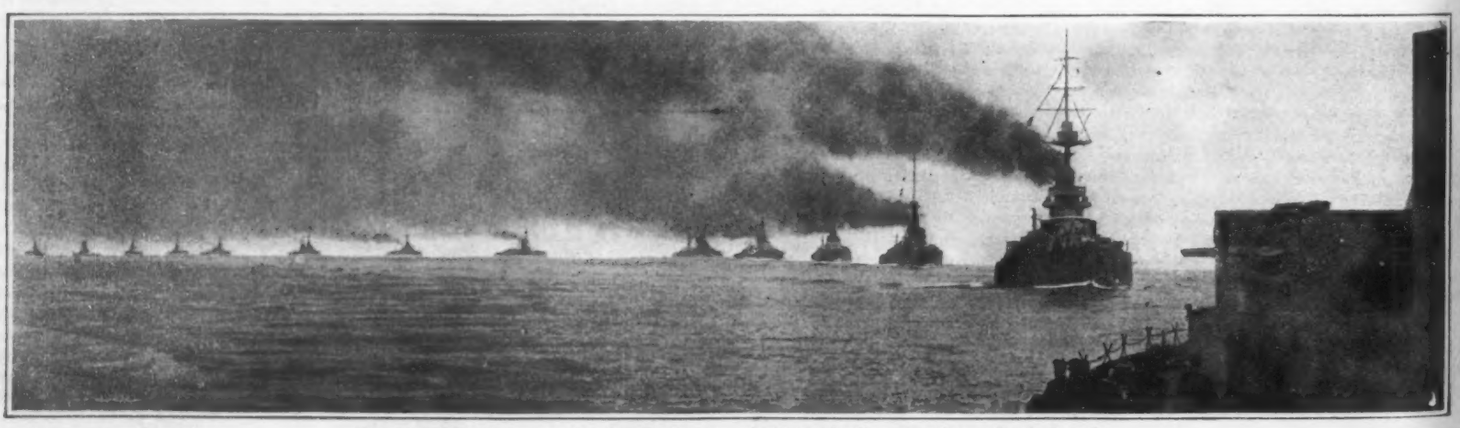
Since the beginning of the war Great Britain has completed eleven battleships, three battle-cruisers, three cruisers, 40 light cruisers, 300 destroyers, 130 submarines, 39 monitors, 60 patrol boats, 600 motor boats and 300 mine vessels, both sweepers and layers. At the start of the war she possessed some four hundred vessels and when the armistice was signed over five thousand flew the British flag, including some seventeen hundred trawlers converted from a hundred peaceful sea pursuits to submarine hunters, patrol boats, net guard vessels, etc.

It is one thing, however to increase ships and personnel, and quite another to have them function perfectly in a short time. It is here, according to the vision of officers high in the British Admiralty, that tradition played a very vital role. As one of them phrased it, "Do you suppose that if Germany had had a naval tradition she would have surrendered her fleet? Do you think that a single battle, even one as disastrous as Jutland, would pen the British Navy up in a harbor, be the fleet waiting outside for it never so large? They had no traditions, nothing up to which they had to live. We had!"

Whatever the reason, however, the sudden expansion of ships and men by nearly three times was not accompanied by any diminution of discipline or effectiveness as far as the results are concerned. Reference is not made here to the Jutland battle, nor the anti-submarine campaign, nor the sweeping of German raiders from the sea, but to the vitally important labors of transportation, accomplished in the face of the submarine menace with a percentage of loss most surprisingly small.

All in all, more than twenty-one million allied troops have been transported by sea. Of these 4,391 have been lost at sea, or .02 per cent of the total carried. To support these men, and give them the wherewithal with which to fight, 86,000,000 tons of stores for the British Naval and Military forces and 24,000,000 tons of stores for the allies, a total of 110,000,000 tons, not including 2,000,000 animals, cows, horses, sheep, goats, dogs and mules, have been carried overseas and guarded by convoy.

The convoys began in March 1917, when the necessity to keep off the submarine raider was alarmingly apparent. Since that date there have been 75,929 sailings convoyed with a loss of 417 ships or .054 per cent of the sailings. To make this a little more real than dry figures succeeded in doing, it may be mentioned that in 1917

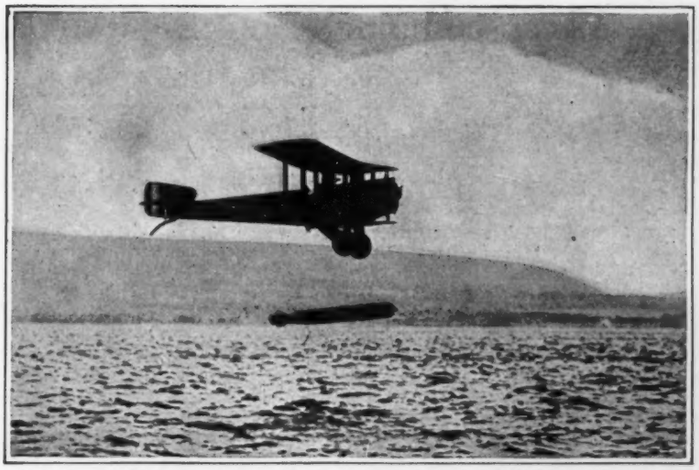


The Grand Fleet on patrol in the North Sea. At times the line was sixty miles in length

Great Britain bought most of the Argentine wheat crop. But the Argentine is far away and there was no prey, not even "Lusitanias" with women and children or hospital ships with wounded men, which the German raider liked better than a wheat ship. England was to be "strafed" by slow starvation and the means were submarine hunters of food ships. Yet the British Navy did its work so well that of the 307 convoyed vessels which aggregated 1,466,000 displacement tons, carrying this wheat, *one* vessel was lost!

Of course, not all convoy work was as successful. Statistics are as yet somewhat unrelated and fragmentary, because Great Britain has by no means gotten well started in the vast work of compilation necessary to publish complete statistics of the war and her part in it. But there are some facts available. For instance, the British merchant steamships of more than 500 tons displacement, to and from ports in the United Kingdom only, were most generally convoyed. During the year from September, 1917, to the same month 1918, an average of almost 92 per cent of such ships were convoyed. Of those which were not convoyed an average of 4.44 per cent were lost. Of the convoyed vessels .79 per cent were lost before or after convoy, while of those in the convoy an average of .58 per cent were lost. In other figures 920 ships, convoyed, lost 5⅓ ships, approximately, while 80 ships unconvoyed, lost three and half ships, approximately. In still other words, the danger to an unconvoyed ship in the zone of submarine menace was over eight times what it was to a convoyed ship . . . with the British Navy on the job.

There is a great deal of talk about the "freedom of the seas" and no one knows just what it means. We know the sea has been anything but free during the period when Germany ran amuck and used her submarines without regard to law, agreement, or humanity. But what freedom of the seas there was . . . and it was enough to put an American army in France which turned the scales, and to maintain food communications so that three nations could fight without starving . . . what freedom of the seas there was came very largely because Great Britain had at the beginning, the ships and the men and the ability and the will to build and transform others; to equip and train the needed personnel; and to use her mighty weapon with the bull-dog tenacity, the quiet courage and the simple, direct effectiveness always characteristic of the performance of her navy and her merchant marine.



Land type British torpedoplane in the act of launching its 2,000-pound torpedo

An Airplane with Wings of Metal

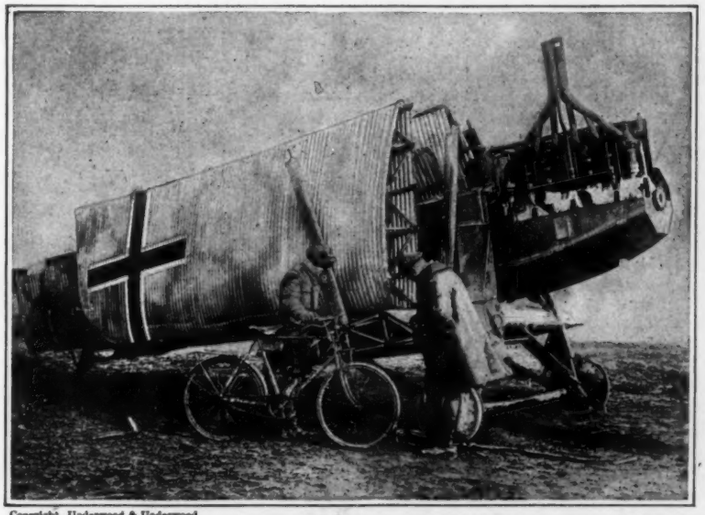
MORE than once it has been suggested that the airplane should follow a more substantial construction. Why keep to delicate wood, guy wires, and fabric? And always the answer has been that, weight for weight, the materials in general use cannot be improved upon.

But the Germans have again gone into new fields and set aside all engineering prejudices. This time it is in the form of the Junker armored machine, which is the first real all-metal airplane.

The Junker armored machine seems to have been designed for attacking trenches. Its fuselage is of the typical German design, and carries armor plate along its flat sides. The slightly curved top is of aluminum. The bottom of the body is formed of three flat surfaces, the middle one of which is horizontal, the other two sloping so as to connect the edges of the horizontal bottom with those of the vertical sides. The engine, a 230 horse-power Benz, is also protected by armor plating, which is detachable so as to allow access to the engine. The armoring is finished off just behind the gunner's cockpit, where it is continued across the fuselage by a curved armor plate shaped to form the gunner's back rest.

The wings, however, are of greatest interest. The internal construction of the wings is in the form of duralumin tubes crossing diagonally and connecting the tubular spars, which latter are far greater in number than is ordinarily found in an airplane wing. In the Junker there may be said to be six spars, if one counts the top and bottom tubes lying vertically above one another as one spar. In section the planes of the Junker are enormously deep, the maximum thickness of the top plane being about 16 inches. The chord of this wing is a little over 8 feet, while the chord of the bottom plane is approximately 5 feet. The wings are covered with light, corrugated aluminum sheets.

From the fact that no trace was found of interplane strut fittings, it would appear that these members have been dispensed with in the Junker. The Junker is made in monoplane and biplane designs. The one shown is probably the monoplane type.



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Junker armored airplane, whose wings are covered with thin corrugated aluminum

The Torpedoplane of Reality

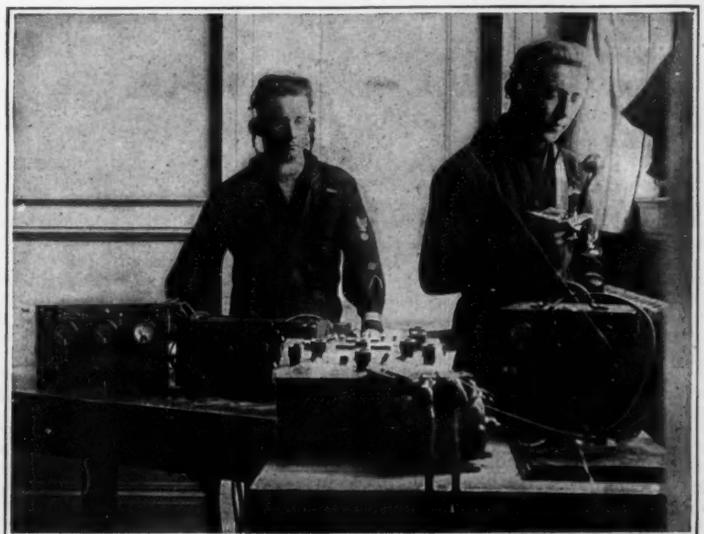
EVER since Rear Admiral Bradley A. Fiske, U. S. N., patented the torpedoplane back in July, 1912, this form of naval weapon has received some attention on the part of naval men. But it has remained for the British and the Germans to give the idea an actual tryout, and this they did during the last years of the great war.

The torpedoplane is nothing more than an airplane or seaplane arranged to carry one or more torpedoes which it can launch at surface targets from a distance of several hundred yards, to ensure accuracy of aim. The British have constructed torpedoplanes in which a single torpedo is carried between the floats or wheels, depending on whether the craft is a seaplane or land machine. The Germans have constructed similar machines. In some instances the torpedoplanes have had single engines, while in others they have been of the more powerful twin-engine model.

British naval officers sank two ships during 1916, by means of torpedoplanes. The Germans retaliated by sinking the British steamship "Gena" by means of one of their torpedoplanes. However, the war ended before either side could try out the torpedoplane on an extensive scale, hence the efficiency of this naval weapon is still a matter for conjecture. It is understood that a single torpedo weighing about 2,000 pounds is generally carried. More torpedoes mean a larger machine, which in turn means a better mark for the enemy gunners. Hence the single-torpedo type seems the best for the purpose.

Wireless Telephony Between Airships and Ground Stations

TWO slender wires not exceeding 75 feet in length; a cabinet no larger than the familiar household breadbox, but mounting various knobs, instruments and bulbs on its front panel; a square, flat box mounting divers instruments, knobs and indicators on its top panel; a diminutive motor-generator set which could readily be carried about by a boy; a collection of tiny dry cells, embedded in wax so as to form compact units of many volts each—that, in brief, is the apparatus which makes possible the carrying on of conversation between airships and ground stations. Such an installation was recently placed on the roof of the Equitable Building in New York city, during a W. S. S. celebration; and the public was treated to a demonstration of wireless telephony between a large Navy dirigible and the station just mentioned.



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Wireless telephone apparatus which connect airships with ground stations

The Navy system of wireless telephony for airships is practically the same as that of the Army; indeed, the same manufacturers supply their instruments to both services. Two types of transmitters were employed in the New York demonstration, both of practically the same size, design and general construction. The wireless waves in each case are generated by so-called vacuum bulbs of the pliotron type, three such bulbs being used with each set. In one set two pliotrons are employed for generating the waves, while the third is used in the modulating circuit which impresses the voice on the waves. In the other set, one pliotron is employed for generating the waves, while two pliotrons are employed as modulators.

The pliotrons are made in the form of electric lamps, with spiral filaments, a cylindrical plate and a tiny grid. The filament operates on a 12-volt storage battery. A 22-volt dry battery is required in getting the bulb to oscillate or produce waves. This task is then taken over by a diminutive motor-generator, which converts low-voltage current into 1,500-volt current for the grid of the

(*Continued on page 104*)

Battery Versus Magneto on the Airplane

A Sequel to "The True Story of the Liberty Motor"

THE further Germany's foes went in the war against her, the more evidence they unearthed as to the thoroughness of her preparation. The tale of industries thrown into confusion by the withdrawal of some German-made or German-controlled essential is a familiar one. In the manufacture of the internal combustion engine, the strategic point held by the Hun lay in the ignition system; a condition had been created under which magnetos—especially magnetos suitable for aviation—were so largely made in Germany that the opening of hostilities left the Allies in a serious predicament.

Toward meeting this situation America made a material contribution. This was made possible partly by our vigorous motor truck development, which had kept our magneto industry in good shape; but above all by a new type of American magneto, just coming into its own at this critical period. The rotary-pole magneto, described in our issue of January 11th, had not reached its present estate in 1914; but it existed and gave service. One of the steps that the Allies took to meet their emergency was the placing in this country of orders for this magneto. First and last, hundreds of thousands were shipped; and their part in Allied control of the air has been anything but small.

Another measure which the Allied engineers must have considered was the alternative of battery ignition. But the opinion prevailed, until the appearance of the Liberty Motor, that a battery was out of place on a plane. The Liberty, however, is a success; and this it could not be if its ignition were an absolute "bust." Its performance accordingly means something to the ignition engineer; but what? It might mean that the battery is to supplant the magneto; it might mean that the two are to be on an equal footing; it might mean that the battery is a sufficient emergency substitute for a magneto; it might mean that a man who is determined to run a plane on battery ignition can get away with it. The only way to decide just what it does mean is by a general hearing of the case of battery vs. magneto.

The battery system consists of two fundamental parts—battery and generator; the rest of the outfit is the mechanism of timing, distribution and control. Since the magneto itself is a generator, without a battery, the obvious question is "Why the battery?" We may let its advocates speak first, and tell us the reason, as they see it.

Concerning Safety Factors

A plane differs from a truck or a car; the pilot can't get out and tinker with his machine, can't draw to one side and await expert aid—he must complete his day's work without irregularity of operation, or not at all. And if irregularity comes, it puts him in peril, where on the ground it merely constitutes an inconvenience. So we must give the aviator every factor of safety; in terms of ignition, this involves two means of creating the vital spark. Then if one staff fails he can lean on the other.

The battery advocate says he has met this requirement. He says that if the battery fails the generator goes on firing, and if the generator fails the battery goes on firing. So he claims he has provided two separate sources of current. The magneto man can do as much only by mounting two magnetos; and this gives the battery a big advantage in weight.

The magneto man disputes all this. He is not satisfied that the generator will go on indefinitely with the battery out of commission. In the absence of the regulator, run from the battery and from the battery alone, he wants to know what is to prevent the generator from going up, and up, and up, until it burns out. But he will not press this point; for he has a more serious one, which the battery man admits. With the battery out, the generator at best will fire only so long as the engine runs continuously; after it once stops, the generator can never start it. We shall return to this.

On the other hand, even the battery man can't claim that the battery will go on indefinitely after the generator fails. His best argument here is that the battery will fire for three hours. It will *last* for three hours, because its capacity is nine ampere-hours and the ignition current is three amperes; but the magneto man says that it will obviously go down below sparking voltage before the three hours are up. But the existence of a period for the battery, rather than its exact length, is the critical point. The magneto man wants to know whether the pilot is supposed to go on with his work for that period, relying upon the single source of spark which is definitely going to quit without warning, or whether he is supposed to drop all business and rush for home the minute his generator goes out. Either alternative seems an embarrassing one.

The Parable of the Sock

A certain laborer banked half his week's earnings in an old sock, and at the end of the month paid the rent out of the sock. He argued that he had thus two sources of funds; if he lost the sock he still had his job, while if he lost the job he had the sock. One day he did lose his job; whereupon he discovered that he could get out of the sock exactly what he had put into it from his pay envelope, and not a cent more.

The magneto man says that the battery booster is in just this position. He says that the battery, charged from the generator, is not a source of current at all; like the sock, it is depository, from which we can get back only what we have salted down in it. If it be suggested that the battery is a source to the extent of its initial charge, the magneto man will point out that to offset this initial sum in the sock, there is a hole in the latter through which 30 per cent of all the electrical funds deposited in it leak away. He will close out this side of the case by asserting that if the battery man wants two independent sources of current, either of which will spark indefinitely after the other quits and neither of which is in any way affected by the quitting of the other—if he wants to compete with the magneto, in other words—he must mount an entire duplicate outfit—battery, generator, and all. Then he loses his boasted advantage in weight.

The magneto man now brings forward *his* claim of positive advantage, which is, a better spark. The magneto spark increases in intensity with the speed of the motor, but otherwise is remarkably constant. The battery spark is admitted to fall off in intensity at high speed; in addition, the magneto maker says it is variable on its own grounds, going down, now and again, to a point that implies a missed explosion. This indictment the battery man of course indignantly denies. The magneto man asserts that his battery oscillographs were made from a stock Liberty ignition set, under field conditions; and he says that if he can get a variable spark out of the battery by fair means, the aviator can do so, too.

So much for positive arguments; what of negative ones? When the battery man is asked to criticize the magneto, he says it has too many moving parts. The magneto man agrees; but he challenges the battery to make a better showing. If the battery could be installed without the generator, it would constitute an improvement under this count; but on an airplane it can't, so it fails to make good its own point. Before the invention of the rotary pole, it might have been argued that the magneto was limited to eight cylinders, and that the battery therefore had an advantage in flexibility; this can no longer be admitted.

"Trouble, Trouble, Nothing but Trouble!"

When we ask the magneto man to stop boosting his outfit and to knock the battery system, he replies that the latter convicts itself. In the army training school at the magneto factory, the bulk of the lectures and the bulk of the literature placed in the student's hands is devoted to explaining to him the construction and the operating principles of the magneto. In the battery school the matter is quite otherwise; a preponderance of the work of his course here is given over to making him acquainted with the 57 varieties of trouble he may expect to meet, and the ways for avoiding and overcoming them. In at least one instance, he is told "Don't touch it; send for an expert!"

The magneto man figures that this state of affairs is natural enough. The battery system comprises a generator and a battery and a couple of distributors and a regulator and an ammeter. He says that accordingly it may be expected to display all the weaknesses found in any of these units, together with the special weaknesses inherent in a complicated electro-mechanical system composed of numerous elements of diverse structure and operation, elaborately interconnected.

Thus, the battery consists of a vessel containing liquid, which must remain intact while traveling on a plane subject to hostile fire in war or exposed to the elements in peace. Before it goes aboard it must have been got to just the right specific gravity by a procedure which the magneto man refuses to believe is possible outside the laboratory. After it goes aboard it must be kept from sulfating. Fully charged, there is no prospect of its freezing; but half discharged, it freezes between 5° and 30° below zero, Fahrenheit.

The magneto man lays stress upon the number of wires and connections in the battery system. He points out that a battery expert has to be an expert in half a dozen lines. He considers that the great number of places in which to look for trouble makes it a matter of more time to put the battery system in order and keep it so. Then he passes to his climax.

The Matter of Starting

The magneto-operated plane is started by an independent, hand-operated magneto. Whenever compression exists in a single cylinder this little coffee-mill affair will start the engine. The battery-equipped plane starts in either of two ways, but always the battery must be in working order. If it is not, we may accept the claim that the generator will fire the engine as long as the engine runs continuously. But the minute the engine stops, the generator without the battery will never start it again, under any terms whatever. This is what our battery friend was getting at when he stated, conservatively enough, that "the engine will continue to run indefinitely until stopped, when *difficulty* will result in starting." (The italics are ours.)

When this machine comes down, the pilot is expected to throw off his ignition switch. But being human, sooner or later he is going to forget this. The battery will then go on discharging until it is as dead as Julius Caesar; and that plane will stay right there until it gets a fresh battery. If this happens at home, it is merely an inconvenience, though perhaps far from a minor one. But when the battery and the engine die at the same time over hostile territory, add one plane and one aviator to the list of missing in action. An aviator flying on his generator alone, with his battery out of commission, knows with complete certainty that anything that stops his engine stops his plane for good.

So much for the case of battery vs. magneto in aerial work. We say nothing for or against the use of the battery elsewhere. But items which on the ground constitute merely offsets to the advantages—mostly of economy—gained by using a battery, become, in the magneto man's mind, conclusive arguments against the use of the battery in the air. For planes, he insists that the precedent laid down in favor of the magneto is a just one.

Prior to the appearance of the Liberty, no ranking plane had ever mounted battery ignition; all records are held by magneto-equipped planes, right down to the altitude record made in the home of the battery, the other day, by a Hispano-Suiza plane, with rotary-pole magneto. Why, then, is the battery ignition found on the Liberty?

What About the Liberty?

The designers of this engine have spoken in these columns. "The True Story of the Liberty Motor," which appeared in our issue of June 1st last, was compiled after close contact with the men responsible for the entire development. We quoted these men to the effect that, while the original commercial plans called for battery ignition, they had shared the general opinion with regard to the desirability of the magneto, and had made every effort to use it; that it had failed; and that when, in this dilemma, they turned to the battery, it had done the job. The first indictment brought to justify this action is that, in the Liberty tests, "owing possibly to the vibration of the engine at high speed, the magnets of the magneto showed fatigue, and gradually lost their magnetic property."

Magneto makers were not content with directing attention to the discrepancy between this and the claim that "tests of the engine showed that there was no noticeable vibration with the cylinders set at this unusual angle." They didn't believe that any amount of vibration would knock the juice out of their magnets; and to prove it, they installed a stock rotary-pole magneto on a Hispano-Suiza eight, and ran it continuously for 55 hours. The engineer of this test says that he didn't make the test on a Liberty because he had then no stock magneto that would fire the Liberty; but that if the vibration of his test was not equal to that of the Liberty, something is wrong with the latter. He records that at the end of the run the magnets were found to have lost exactly three-tenths of one per cent of their strength. His point of view is that if the Liberty designers are right in their allegations it constitutes a slap, not at the magneto, but rather at the engine that rattles to such an extent.

When the Liberty experimental work was being done,

(Continued on page 104)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The German Losses at Jutland

To the Editor of the SCIENTIFIC AMERICAN:

There are a number of interesting naval items more or less clouded in mystery that I have been looking to your columns to clear up since the surrender of part of the German fleet and the admission of German defeat at Jutland by the German naval officer, Captain Persius. The latter's confession bears out Admiral Jellicoe's report of the battle concerning heavy German losses that could not be positively confirmed at the time owing to the mist, smoke and darkness. But with the most powerful part of the German Navy in a British harbor and a British squadron guarding the balance at Kiel and Wilhelmshaven, the identity of the "severe losses" of the High Seas Fleet still remains unknown. We were led to believe that those losses in capital ships in addition to the admitted loss of the battle-cruiser, "Lutzow" and battleship "Pommern," consisted of at least one other battle-cruiser, supposed to be the "Von der Tann," and two dreadnoughts. But the original "Von der Tann" and not a new "ersatz" surrendered the other day along with four other battle-cruisers. There remains the probability that the battle-cruiser "seen to sink" was the Greek "Salamis" building in Germany in 1914 and taken over. She is approximately of the same tonnage as the "Von der Tann" and probably similar in appearance and the Germans took advantage of the uncertainty surrounding her, in concealing her loss by stating that only five battle-cruisers took part in the fight and then in answer to claims of the British as to battle-cruiser losses, by proving the existence of all but the "Lutzow", which loss they subsequently admitted; *i. e.*, "Seidlitz," "Moltke," "Derrflinger" and "Von der Tann." The British believed that the "Hindenburg" took part also, but this would bring the German battle-cruiser strength to seven, while the British only reported a total of six. Therefore, if the "Hindenburg" was completed in time to take part in the fight, which I doubt (and this ought to be easy to ascertain now), then the "Salamis," or whatever German name she bore—did not, but if she did not she would undoubtedly have been surrendered on November 21st as the British demanded all the German battle-cruisers. It seems that probably she was the vessel sunk in action, but the world awaits confirmation.

Now no accurate account of the Battle of Jutland can be written until these matters are cleared up and when we come to German dreadnought losses, there is further confusion. It is known that all the German ships of this class that were completed at the time, 17, were in the fight, *i. e.*, four "Koenigs," five "Kaisers," four "Oldenburgs" and four "Nassaus." The British claim the destruction of two. But all five "Kaisers" and three of the four "Koenigs" surrendered, and the other "Koenig" was interned at Kiel, not being in condition to put to sea (all of them the original ships and not "ersatz"). Therefore, the loss must have been sustained by the other squadron of eight "Nassaus" and "Oldenburgs." The press dispatches coming from Germany at various times together with photographs have disclosed the existence of most if not all of these eight vessels, the most recent dispatches giving accounts of the revolutionary movement among the sailors mentioning a number of them by name. It has also been stated that their surrender was not demanded, because it was known that their armament had been removed to the Western Front and much of their armor plate, fittings, etc., taken for use in new submarine construction owing to the steel shortage and Germany's sole faith in the U-boat. If this much was known before the armistice, the knowledge of the mere number of these vessels must have been. Certainly it is now. It was also known that Germany stopped building capital ships in 1916, three of the four "Sachsens" still being uncompleted. The fourth, the "Bayern" was surrendered. No statement has been made by the British since they had access to the German Naval bases of the absence of any of these dreadnoughts or of any other pre-dreadnoughts save the "Pommern."

As it would be natural for the Admiralty to give definite proof of Jellicoe's report concerning German losses and of the measure of the British victory we must assume that all these vessels are afloat. Where then are the "severe losses" commonly believed to have been sustained by the Germans and stated as a fact by Captain Persius? The mere fact that the High Seas Fleet never came out since Jutland except to surrender unquestionably gives to Britain the laurels of that action in the broad sense, but to a layman at least, unless definite statements of proof of German losses in capital ships other than the old "Pommern," the "Lutzow" and (giving Britain the benefit of the doubt), the "Salamis" are forthcoming, credit must be given in all fairness to the much despised High Seas Fleet so ignobly given up for balancing the above loss (together with four light cruisers, nine destroyers and one U-boat), against the destruction of three British battle-cruisers, three old armored cruisers and eight destroyers. Another interesting naval item in doubt is whether or not there is in the Grand Fleet a dreadnought named "Audacious" replacing the ship lost in October 1914. Can you enlighten a constant reader?

HAROLD M. KENNARD.

Nova Scotia.

[*We have already stated in these columns that, in the absence of an official report on the subject, the statement made by the Germans after the Jutland battle would seem to be correct, so far as their losses are concerned. Captain Persius seems to imply that the losses were greater, and he ought to know The point is well taken regarding the "Salamis." The "Audacious" was mined early in the war and sank. She is reported to have been raised, but we doubt it.*—EDITOR.]

A Wanton Waste

To the Editor of the SCIENTIFIC AMERICAN:

According to the daily papers of December 14th, a collection of 2,525 dangerous weapons taken from criminals and others during 1918 and valued at $30,000 was thrown into the ocean by the New York police department. The item caught my eye rather forcibly and I thought it ought to be brought to your attention in your capacity as moulders of public opinion. In these days of high pressure conservation it seems almost incredible that any state officials should be guilty of throwing away $30,000 worth of material, which, according to the clipping, did not contain any explosives or other such dangerous substance. It is obvious that the stock of the pistols, revolvers, etc., must have been of high quality metal which could easily be reclaimed and put to more legitimate use.

W. SEGERBLOM.

Exeter, N. H.

Concrete Roads for Heavy Traffic

To the Editor of the SCIENTIFIC AMERICAN:

"Some Motor Truck Economics," appearing in the SCIENTIFIC AMERICAN for December 28th, 1918, well describes the inadequacy of our present highway system for motor truck traffic. The failure of our roads under this new means of transport has been very general. Yet there are exceptions to this general unpreparedness of our highways which should not be forgotten—exceptions which are due to the foresight and energy of progressive communities.

Notable among these are the extensive concrete road systems of Wayne County, Mich., Milwaukee County, Wis., Huron County, Ohio, Marion County, Ind., and Vermilion County, Ill. In all of these counties concrete roads have stood up under motor truck hauling whether it be trains of government trucks, supplies for manufacturers, loads of coal, farm produce, or miscellaneous commodities.

The statement, "Wherever the big army trucks have run constantly, there have roads gone to pieces," is true in most cases, but not when the route was over well constructed, hard surfaced pavements. From Detroit, long government truck trains have left for the coast over Wayne County roads and the roads have been fully adequate. Local motor car traffic over Wayne County's 150 miles of concrete roads is enormous and by July 1st, 1918, there had been licensed 9,988 motor trucks and commercial vehicles and 57,633 passenger cars. Traffic on Woodward Avenue on June 10th, 1917, in slightly less than 14 hours amounted to 11,000 motor driven vehicles.

Similar, though perhaps less dense, traffic passes over the other concrete systems, so that while adequate through routes are yet to be constructed, a number of communities are already prepared for the motor truck.

H. COLIN CAMPBELL.

Chicago, Ill.

Finger Print Classification

To the Editor of the SCIENTIFIC AMERICAN:

To those persons, who for any reason, find it troublesome to use the old or improved Henry System of Finger Print Identification, I suggest the use of the Hollman Notation as adapted to all purposes and being simple and accurate.

In the Hollman Notation each accepted specific style of finger print is permanently assigned a numeral as follows: Whorls (1); ulnars (loops) (2); central pocket loops (3); radials (loops) (4); lateral pocket loops (5); tented arches (6); twinned loops (7); arches (8); accidentals (9). The cipher (0) is used wherever a finger or fingers are missing or has the finger print ridges permanently mutiliated; otherwise the dash (—) is used until superseded.

It will be noticed that the even numerals are assigned to loops-arches, and the odd numerals to the whorls-composites. In making an index number or fraction there are five places, which give a number in the tens of thousands, the left-hand or highest place being assigned to the thumb, next (to the right) the first finger and so on to the units place which is assigned to the fourth or little finger. The right hand is the denominator of the filing fraction; the left hand is the numerator.

Thus the Henry Classification $\frac{1\ aA}{1\ rU}$ 13 would read $\frac{42,222}{88,222}$ 13 in the Hollman Notation. The first two numerals of each number are the style of each thumb and index finger respectively, then the second, third and fourth fingers. 13 is the number of ridges in the loop of the right fourth finger.

The Hollman Notation is self-indexing and interpreting and its scope seems to be unlimited Determination of styles (types) is in accordance with the principles laid down in The Finger Print Instructor by Frederick Kuhne (Munn & Co., 1916).

F. H. ROBINSON.

Brooklyn, N. Y.

An Open Letter from the Secretary of Labor

To the Business Men of the United States:

Every public discussion shows how sincerely and eagerly the business men of the country are seeking a labor policy that will enable them to take advantage of the many commercial opportunities awaiting them. Business men are coming to recognize generally that efficiency in production and consideration of the interests of workers are inseparable.

It is natural that these men turn to the Government for leadership in dealing with a problem that is national in scope and interest. The tendency of government is toward closer relations with industry. The research work to secure the data and determine the standards as the basis of business organization can best be performed by a disinterested governmental agency, able to gather the experiences of all and to reach conclusions based upon widest information.

The Department of Agriculture, the Department of Commerce, the Department of Interior, have constantly been developing more practical service to the interests they serve. There is an analogous service the Department of Labor can perform. Just as the Bureau of Foreign and Domestic Commerce furnishes information on resources, transportation and trade of foreign countries, the Bureau of Mines advises mine operators on technical problems, safety and sanitation standards, the Department of Agriculture furnishes farmers the scientific information necessary to successful production and sale of farm products, there is a scientific field in which the Department of Labor can serve as consulting expert to employers and employes in industrial production. That field includes sanitary and safety standards, the administration of measures necessary to prevent physical disabilities, and the relations between managers and employes known as employment problems.

This service is distinct from that performed by the Mediation and Conciliation branch, which deals with working conditions and industrial relations as controversial issues between employers and employes. Anticipating the increasing importance of establishing working conditions on a scientific basis, the Department of Labor created the Working Conditions Service. The work of the Service is conducted through three coordinated divisions: Division of Industrial Hygiene and Medicine, Division of Labor Administration and Division of Safety Engineering.

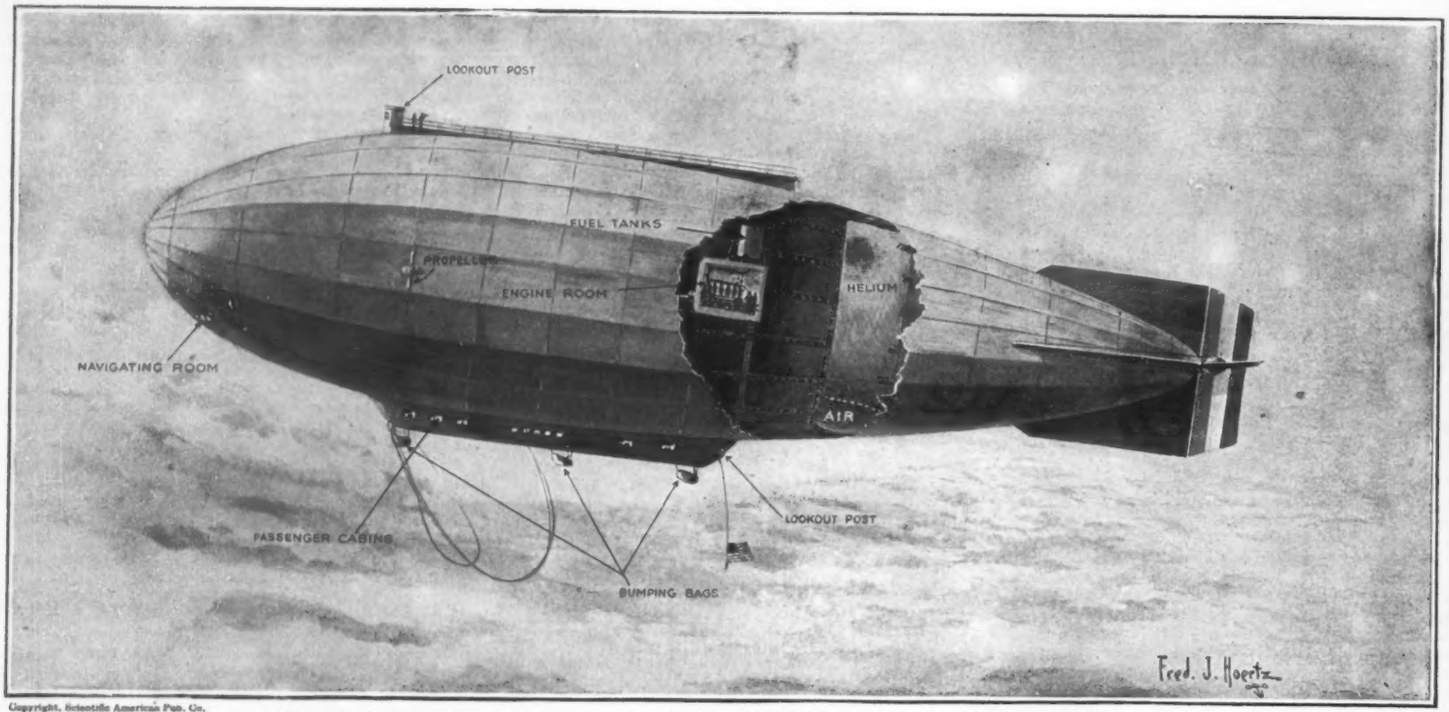
The Division of Industrial Hygiene and Medicine will develop standards of sanitation and medical practice in industries. The personnel of this Division is detailed from the United States Public Health Service.

The Division of Labor Administration will advise employers as to employment systems and labor management policies, and assist in putting into operation standard policies.

The Division of Safety Engineering will develop standards and practices for accident prevention, and advise employers as to safety methods best adapted to their plants.

The Department of Labor offers business practical service at a time when its need is manifest. This assistance is available to owners and managers of industrial establishments in working out labor policies and standards.

W. B. WILSON, *Secretary of Labor.*



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Our artist's conception of the passenger-carrying dirigible of the near future, making use of helium gas

Airship Versus Airplane

Salient Features of the Two Types of Aircraft With Regard to Their Applicability to Passenger Transport

By Ladislas d'Orcy, M.S.A.E.

IN last week's issue of the SCIENTIFIC AMERICAN *we announced that helium could now be produced on a commercial scale cheaply enough and in sufficient quantity to replace hydrogen in balloons and airships. Because helium is a non-combustible gas its use will result in material changes in the design of dirigibles. The engines can actually be placed inside the shell of the balloon bringing the propellers on the axis of head resistance and this resistence can be cut down materially by preserving a perfect stream-line design, unbroken by suspended cars and a tangle of stays. A possible helium airship of the future is illustrated herewith. We also show by illustration the lift of helium as compared with hydrogen and the present cost of helium as compared with its cost before the war. A new future has been opened to the airship and its advantages as compared with those of the airplane are here discussed.*—EDITOR.

NOW that the quantity production of a non-inflammable lifting gas—helium—has eliminated the most serious defect of airships, *i. e.*, the truly disproportionate fire risk their method of sustentation involved, there cannot be the slightest doubt but that the major, if not all, problems of aerial transport will in the near future be solved by the airship, and not by the airplane.

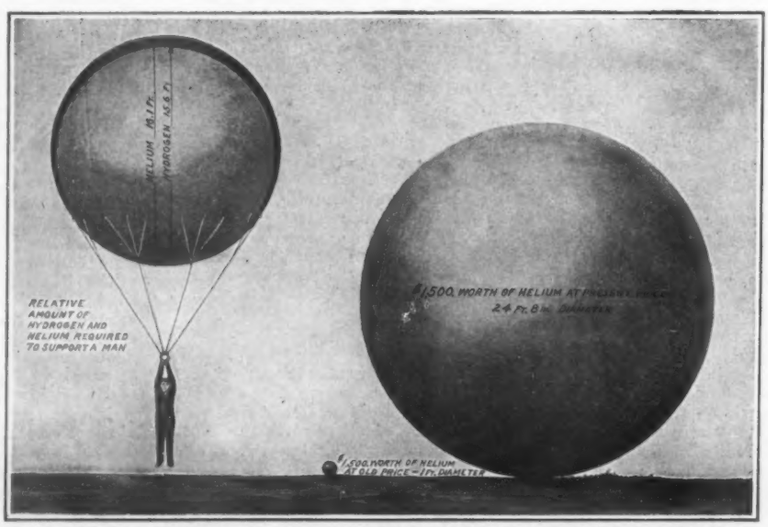
Such a statement is likely to rouse the ire of airplane manufacturers; it is nevertheless based on irrefutable facts, as will be seen hereafter.

Taking into consideration only essential factors, the respective merits and defects of the airship and the airplane for commercial purposes may be reduced to the following terms.

Security

In the airship sustentation is achieved by means distinct from propulsion, whereas in the airplane forward motion, generated by the propelling apparatus, is the necessary condition of lift. Therefore, while an airship can stay aloft regardless of engine stoppage (accidental or voluntary), a failure of the airplane's power plant necessitates an immediate descent in gliding flight.

This feature furnishes one of the most serious objections to the use of the airplane as a passenger-carrier, for a forced landing is not very pleasant to visualize when occurring on vast stretches of wooded or mountainous country, or the Northern Atlantic in mid-winter, for example. In this connection it is interesting to recall that in a paper read last year before the Royal Aeronautical Society the suggestion was made to establish along future lanes of aerial transport a chain of landing grounds, *not more than ten miles apart*, so airplanes in distress may always find level areas within the range of their gliding angle. That such a scheme, entailing, as may well be inquired, an enormous expenditure, should have been seriously suggested by an enthusiastic advocate of commercial aviation, who is by the way one of the largest British airplane manufacturers, is highly significant because it emphasizes the fundamental defect of all heavier-than-air craft, that is, the insufficient security afforded by dynamic sustentation.


HELIUM 39.2 P.P.
HYDROGEN 45.8 P.
RELATIVE AMOUNT OF HYDROGEN AND HELIUM REQUIRED TO SUPPORT A MAN
$1500 WORTH OF HELIUM AT PRESENT PRICE
24 Ft. 8 In. DIAMETER
$1500 WORTH OF HELIUM AT OLD PRICE—17 Ft. DIAMETER

Lift of helium and hydrogen compared; also cost of helium now and before the war

It is true that load-carrying airplanes have been developed during the war in which the risk of a forced landing is somewhat reduced because the motive apparatus is split up into several power units. But even so the risk is only lessened, and not eliminated, for it is materially impossible that a twin-engined airplane, for instance, carry when flying on one engine more than one-half its indicated full load—unless, of course, the machine is so designed as to carry its full load on one engine, with another engine kept idle for emergencies. The latter solution—quite regardless of mechanical difficulties—is conducive to such a waste of carrying capacity that it cannot be seriously entertained for a moment.

It has been variously suggested that could the airplane be fitted with lifting screws, whereby it would be able to hover like an airship, the principal objection, on grounds of insufficient security, to its use as a passenger carrier would be eliminated. This is, however, a fallacy, because—without discussing the feasibility of such a scheme—the lifting screws would, just like the propellers, be subject to stoppage through engine trouble. Now it may be argued that aeronautic engines will eventually attain a degree of reliability that will virtually eliminate the risk of a forced landing. While this assumption seems justified, there is nevertheless one specific case in which even engine reliability cannot prevail against the inherent defect of the airplane; namely its inability to hover.

This case is the occurrence of fog,

which will constitute perhaps the most serious problem affecting the successful operation of commercial flying services. If a fog bank covers the aerodrome, an incoming airplane will have to fly round and round until the fog clears away—or the fuel supply gives out; under the same circumstances an airship will stop its engines and hover until a landing can safely be effected.

The superiority of the airship over the airplane in affording security to passengers under the most difficult operating conditions is thus manifest. A Zeppelin-type airship, in which floatation is secured by 20, or more, separate gas-bags, is fully comparable as to safety to a steamer fitted with watertight compartments. Just as a steamer may spring a leak and have several watertight compartments flooded without sinking, so can a Zeppelin maintain its buoyancy even if several of its gas-bags should be pierced. Injury of this sort may by the way be mended in flight, because balloon fabrics can be patched like automobile tires; it follows that airships of the rigid type have little fear of accident on this score.

On the other hand it is true that atmospheric conditions (sudden variations of temperature, a heavy rainfall, snowstorms, etc.) may cause a considerable reduction in the lift of airships; this feature may appear as a drawback of lighter-than-air craft, but need not cause real concern provided supply tanks, for recharging the gas-bags in the air, and a sufficient amount of ballast are carried on board.

Reliability

Security in operation is, as has been seen, mainly a matter of sustentation; reliability is one of propulsion. Next to safety, ability to reach within a reasonable time limit the place of destination is the most important requirement that must be demanded of commercial aircraft.

Thus defined, reliability in operation depends (1) upon the trustworthiness of the propelling apparatus, and (2) upon the maximum speed the airship is capable of developing.

Now, engine reliability can be achieved more easily on airships than on airplanes because on the former the great buoyancy permits the use of comparatively heavy engines; these may furthermore be throttled down for long stretches—when flying before the wind, for instance—which relieves them of considerable strain, whereas on airplanes the engines have to be run most of the time at full power. Another point in favor of the airship is that, owing to its independent sustentation, minor engine repairs can be effected in flight.

The speed factor, if viewed superficially, very greatly favors the airplane, however. Speeds up to 160 m. p. h. have been made by airplanes, whereas airships have not exceeded 75 m. p. h., from which the conclusion may be drawn that airplanes are much more independent of adverse winds than airships. While this is true to some extent, it should be noted that the airplanes endowed with the highest speed are single, or two-seater machines carrying a useful load of but a few hundred pounds, whereas great load-carriers, such as the Handley-Page for instance, do not exceed as a rule 90 m. p. h. The superiority of the commercially usable airplane over the airship is therefore not so very marked with regard to speed. Furthermore, the Zeppelin, which is the fastest type of airship in existence does not embody the hull shape most favorable to high speeds, because it was designed for quantity production; it may be assumed, that by adopting a finer streamline hull the speed could be bettered some ten miles per hour.

Loading Efficiency

The great load-carrying ability of airships naturally enables these craft to undertake cruises with heavy cargoes which entirely outstrip in importance anything large airplanes have so far achieved. A Zeppelin of the 1917 model (60 gross lift tons, 1,200 h.p., 70 m. p. h.) could actually cross the Atlantic, carrying 100 passengers with 50 pounds of baggage each, and a crew of 30, at a mean speed of 50 m. p. h., which comes to say that the trip from Ireland to Newfoundland would be made in 40 hours. Recent reports from Germany indicate that the Zeppelin Co. are engaged in building a fleet of transatlantic airships, with which they expect to establish a passenger and mail service as soon as peace is signed. These airships are to have a gross lift of 115 tons and a total horsepower of 2,400; they will carry 30 tons of fuel, provisions, etc., 45 tons of cargo and mails, and 100 passengers, that is, the useful load will exceed 80 tons.

These figures would seem fantastic, were it not a well known fact that in airships the loading efficiency, that is, the ratio of useful to gross lift, greatly increases with an increase in size, whereas in airplanes it remains at best constant. The reason for this is that the lift of an airship increases as the volume, or the cube of the dimensions, while that of the airplane increases only as the square, that is, like the wing area; on the other hand the weight of the structure increases on both craft in proportion to the superficial area.

Thus, the loading efficiency does not as a rule exceed 35 per cent on airplanes—this regardless of size—whereas on the Zeppelin type airship it has grown from 10 per cent, in 1900, to 35 per cent, in 1912, and to 58 per cent, in 1917. That the leading efficiency of the new, 115-ton, Zeppelin may reach 70 per cent is therefore entirely within mechanical possibilities, and the importance such a craft would possess in rapid, long-distance transport is obvious.

Comfort

In a discussion of the merits of aircraft for commercial purposes the question of comfort afforded to travellers is by no means negligible, quite regardless of all speed inducements the machine in question may hold forth. Indeed, if the airship, or the airplane, is to become an accepted means of travel, comparable to steamships, railways, etc., then the aerial traveler must be assured of finding reasonable comfort on board aircraft.

(Continued on page 104)

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Removing the sandbags, boards and other protection from the Vendome Column in Paris

Uncovering Paris Monuments Now That Air Raids Are Over

WITH the danger of air raids and bombardment now past, Paris is again displaying her art works to her appreciative visitors. Already, many of the carefully protected public monuments have been uncovered and restored to their peacetime appearance. Typical of this activity is the accompanying view, which shows a group of workmen engaged in removing the sandbags, cement walls and boards from the stately Vendome Column.

S. A. T. C. Salvage

WITH demobilization of the Army and Navy Units of the Students Army Training Corps at Stevens Institute of Technology at Hoboken completed there are left nearly 500 men who will go on with the regular mechanical engineering course, only about 70 having withdrawn. This is regarded as an exceptional record and leaves the total college attendance close to the highest record of previous years which was 520. Even this may be surpassed by the return of men who left the course to volunteer in the early days of the war. A number of these men have already applied for reinstatement.

Disastrous Explosion of a Tank of Molasses

WHAT is there in molasses that would make it explode, particularly in winter time when the sticky syrup is proverbially slow? Two weeks ago a large tank of molasses exploded in Boston killing a dozen persons and injuring 50 more, and no completely satisfactory explanation of the disaster is obtainable.

The tank was a huge cylindrical structure with a capacity of two million gallons. Without an instant's warning the top was blown into the air and the sides were burst apart. A city building nearby, where the employees were at lunch, collapsed burying a number of victims and a fire house was crushed in by a section of the tank, killing and injuring a number of the firemen. Wreckage was scattered in all directions while a deluge of molasses spread over the ruins and into the street, suffocating many of the injured and increasing the difficulty of rescue.

The only plausible explanation of this unique disaster is based on the assumption that there was an accumulation of alcohol in the tank. In order to have the molasses fluid enough to flow readily through pipes, steam-heating coils were placed in the tank and it is quite possible that there was some fermentation, generating a certain amount of alcohol. It may be that the steam was left on too long, warming the molasses sufficiently to vaporize the alcohol and this, mixing with the air at the top of the tank, resulted in the accumulation of an explosive mixture which needed but a spark to touch it off. Possibly an attendant lowered a lantern into the tank or dropped a lighted match into it to determine how much molasses it contained and then—the accompanying photograph tells the rest.

Copyright, Underwood & Underwood

Havoc wrought by the explosion of a 2,000,000-gallon tank of molasses

A group of Boy Scouts that made good on the slogan, "Every Scout to feed a soldier"

Harnessing Boy-Power

The Story of the Boy Scouts—What They Are and What They Have Done

By William B. Ashley

WHAT is boy-power?

Boy-power is exuberant boy energy. After the normal scalawag lets loose a requisite amount of energy on study, eats, sleeps, and trying to behave, he has a whole lot of energy left over.

This exuberant energy is employed by the average boy in a number of ways. He uses it to generate loud yells at sudden intervals; to move his arms and legs in games like baseball and football, tag, and athletics generally; it makes catapults of his arms when snow is abundant and motors of his legs when skating is in vogue. It helps him roll cigarettes, kick a tin can along the sidewalk, fight, ring doorbells, run to fires, stone cats and dogs. And it sometimes is employed in shoveling the snow off of sidewalks, cutting wood, pushing a lawn mower around, spading a garden, running errands, and even in holding down a job after school hours.

Experts state that the average boy is awake approximately 5,500 hours in the year. Taking the year through, 900 of these hours are spent inside the school room, 1,500 inside his home, and 100 inside church and Sunday School. Three thousand of his waking hours presumably are spent outdoors working off his exuberant energy. There are exceptions, and the war has somewhat changed the general conditions, but this analysis of a boy's time is accurate enough for the purpose in hand.

What is the product of the use that the boy puts his exuberant energy to, the 3,000 hours in a year? As there are around 8,000,000 boys in the United Stated whose ages run from 12 to 18, this question is important.

In a large degree it is muscle. Good health can be included: a good constitution for the years ahead. These are valuable assets. But suppose this exuberant energy, this boy-power, can be harnessed so that it will produce other benefits to the boy himself and very specific benefits to the community and the state without robbing the boy of muscle or health, or of any of the worth-while fun he has while directing the use of his own exuberant energy? Suppose also that in this process the boy who formerly would have arrived at the threshold of business life 15 per cent prepared (let us say), should by this process arrive there *35 per cent prepared:* 20 per cent more efficient at the very start of his business life.

Hartford, Conn., was to have its annual clean-up. The Chamber of Commerce called upon the 350 Boy Scouts of the city to assist. At nine in the morning they got into action. They distributed 54,000 circulars to householders, inspected 15,225 front and backyards, reported 2,673 bad conditions, completing the task in 3½ hours. In commending the thorcughness of their work, the Secretary of the Chamber of Commerce wrote: "Who besides the Boy Scouts could have done the indispensable work these loyal boys did?"

Of course, that lets the cat out of the bag. The Boy Scout Movement, as an efficient and ideal method of harnessing boy-power, is the subject of this article.

The catalog above included "running to fires." From time immemorial the boy has been an infernal nuisance to the firemen. But in various localities Boy Scouts are being organized as fire patrols. They have a system of quick mobilization. Special automobiles carry them with their equipment of fire rakes, axes, water bags, and so forth, to any point where they may be needed. The law gives them the right to commandeer plows, teams, and men between the ages of eighteen and fifty-five years. The scouts are authorized to tear down fences, enter lands, cut trees or do anything reasonable in the discharge of their fire duties. This is an example of how boy-power formerly employed in making the boy a nuisance, harnessed, can make him an asset to himself and his city.

How did this idea of organizing boys for civic service come about?

The germ of it is found in the daily good turn, which every Boy Scout is expected to do for someone without pay. The good turn is a practical expression of the ability of a boy to do things for himself "and others." One great object of the Boy Scout Movement is to help boys develop ability to do things for themselves and others.

The good turn is either spontaneous, or the result of deliberate search for an opportunity. It must be practical. It can be an individual act, or performed by a group of scouts. For example, a number of scouts on a car one night discovered an old lady who had lost her "bearings" (as they put it), and made it their duty to assist her in finding her destination. Again, scouts at one point take turns in wheeling an invalid woman to church. They have given poor boys under scout age an outing. A troop of scouts picked 450 pounds of blackberries, the juice of which was sent to an army hospital, and also gathered special moss for the hospital. They take charge of the feeding of birds in and about their towns. They distribute bags to homes for the collection of waste, and afterward gather up and sell the junk. The Park Commissioner of New York city estimated that the help of scouts in taking care of Central Park saved the city at least $6,500,000 during 1916.

Such good turns as these and others in great variety are duplicated continually throughout the United States. A number of cases are reported in which scouts have

Some more Scout work that looks toward improved food supply

established public drinking places; a much larger number where they are responsible for the raising and lowering of the flag on public buildings; and a still larger number in which scouts are responsible for adding to the attractiveness of their home cities.

Perhaps this process might better have been called "*storing up* boy-power." A boy's muscle grows by the use of it, and his ability to do things increases by practice. It's the play spirit, the teamwork spirit, the idea of doing something out of the ordinary, that keeps the Boy Scout at it. And all the time he is storing up within himself a big reservoir of power that will make him an invaluable citizen when he comes of age.

Let's see how this works out.

The Good Roads movement occupies the entire attention of many capable men. It is a big subject in our national development. Yet Boy Scouts of Manorville, Pa., under competent leadership put a considerable stretch of road in thoroughly good shape by approved methods. Savannah, Ga., scouts, 50 or 100 strong, get out into the surrounding country and select pieces of road which need repairing and go to it. It is a regular scouting stunt to them, *and to a considerable number of troops in other sections of the country.*

Boy Scouts acting as aides to the Fire Department get fun and valuable training of every description

Combating destructive pests of every kind is one of the vital tasks of government experts. But Boy Scouts of Ashland, Ill., undertook the removal of the deadly barberry plant from the grounds of everybody in that town. The breeding places of mosquitoes in Memphis, Tenn., were located by Boy Scouts who also assisted in their extermination. At Glen Cove, N. Y., the scouts made it their duty to kill off the thousands of caterpillars that infested the trees. Typical civic good turns that are duplicated again and again. An appropriate line of police work was assigned the scouts at Fargo, in stopping vicious pranks on Hallowe'en night. It is the common thing for scouts to be called upon to hunt lost children. And as stated, firemanship is proving one of the best means of utilizing exuberant energy. Great tastes, these, of manhood responsibilities that lie just ahead!

The war has doubtless taught all nations the need of conservation of natural resources. What's that got to do with a glorious outdoor hike on Lincoln's Birthday? Nothing. But come to think of it, Abraham Lincoln was a rail splitter. What of that? Well, doesn't that suggest splitting wood? Why not a fuel hike when every scout gets out his scout axe and gets into the woods and converts fallen timber into firewood for the needy? And it wasn't only on Lincoln's Birthday by any means that the scouts practiced that form of conservation. *Anti-destructiveness* is an underlying principle of scouting. Men who lay hold of the responsibilities of government with that idea imbedded in their natures, will never be grafters.

Too much cannot be said in commendation of the method of education that makes a boy delight in doing well such serious things as these. You can imagine the thrill of pride which young scouts of Abilene, Texas, felt when they helped the Chamber of Commerce to promote a municipal water system and to select a site for a mechanical and agricultural college. Something has happened when a boy, instead of throwing sticks and stones up into a horse-chestnut tree and shinning up any tree along the walk that takes his fancy, regardless of broken branches, will laboriously make a complete census of the 14,083 trees within his city's limits, tabulating 61 different varieties, and doing it so accurately that when results were checked the work was found correct. And a boy who as a scout has helped to notify 11,500 natural gas users between 10 P. M. and 3 A. M to turn off their jets because of an accident, has stored up for the days of his manhood to come, the power that arises only from a sense of responsibility.

When boys will do this for the health and beauty of their town, civic service has them for keeps

The climax thus far in the development of the Boy Scout Daily Good Turn into organized civic service, was the tremendous contribution of the Boy Scouts to our Government's conduct of the war. These scouts, it must be remembered, are boys out of our own homes. They are not phenomenal boys. They come from all kinds of homes, of all nationalities, of every religious creed. They run from 12 to 18 and 19 years of age, averaging around 15½. They are the sons of poor people and of rich people and of in-between people. They are likable lads and lads who are hard to like. They know how to behave or they are little ruffians willing to learn. Just plain American boy. But the scouting program grips them, the stern Oath and Law with its 12 "points," gives them moral backbone. The program of outdoor activities gives them expertness in athletics and camping and in wood lore. Successive stunts in civic service tone up their sense of solidarity. The Nation is forced into a war with another nation, and from sea to sea this great brotherhood of "plain American boy" leaps to its feet and flashes to the President a sturdy message, "*The Boy Scouts of America stand for 100 per cent patriotism and unqualified and energetic support of the Government in every way.*"

Follows without comment, the stirring record that made that message good:

In three Liberty Loans made 1,343,018 sales, amounting to $206,862,950.

Returns to date on Fourth Loan indicate over $100,000,000 of sales.

Sold War Savings Stamps to the value of $22,997,260, and still going strong.

Located 20,758,660 board feet (5,200 carloads) of standing walnut.

Collected over 100 carloads of fruit pits, enough to make over one-half million gas masks.

Responsible for over 12,000 War Gardens actually reported, with thousands more not reported in detail. In addition to this, many thousands of scouts worked on farms.

Distributed over 30,000,000 pieces of Government literature.

Assisted Red Cross continuously in its work, and served in every membership and financial drive.

Assisted the United War Work Committee's campaign for money.

Collected great quantities of books for shipment to soldiers in France.

Performed many services for the selective Service Boards and the Government Intelligence Bureau.

This nation can no longer afford to let its boy-power go to waste. It is not enough that it shall construct muscle and good constitutions. We must have more by-products such as these. There are 8, 10, 12 million boys in this country all the time. Only about five per cent of this vast total is under leadership that conserves their "power," directing it back upon themselves in self-improvement and directing it outward upon the community in civic

(Continued on page 106)

Scouts making a careful condition census of the trees of their town

Making a model of a bridge that will later be erected for actual use outdoors

The Heavens in February, 1919

A Few Suggestions as to the Ages of the Stars

By Professor Henry Norris Russell, Ph.D.

WE had occasion last month to speak of the extraordinary brilliancy of certain stars in Orion and the neighborhood. Such objects challenge the imagination in many ways—their great size, extreme brightness, and the very high temperature to which they owe their luminosity. But they are most impressive of all when we consider them, not from the standpoint of the present moment, but from that of their past history and probable future duration.

Estimates of the brightness of the stars, of very fair precision, were recorded by Hipparchus, more than two thousand years ago. These suffice to make it certain that the general aspect of the constellations, as regards the brightness and the position of their stars, has not changed perceptibly in these 20 centuries. Indeed, the few doubtful cases, in which it looks at first sight as though a few stars might have changed in brightness, are more probably due to errors in the early estimates, or in the copying of the manuscripts, than to actual changes in the sky.

Direct human observation makes it clear, therefore, that in the life of a star 1,000 years is but a short time. This is of course what we should expect, from our present knowledge of the great age of the Earth, and of the life which has for so long been evolving on its surface. On general principles, we might well expect to find that the life of our solar system far exceeded in length that of this little planet of ours, and that the life of the great system of stars was again far more extended in duration than that of our own small part of it. But what evidence, direct or indirect, do we at present possess upon the matter?

The Geologist's Contribution

Let us begin with the age of the Earth—or, rather, of the fossiliferous strata upon it, which, as all geologists agree, give us only the latter part of the history of the evolution of living things. This is not the place to enter into details regarding the arguments which have led geologists to make rough numerical estimates of the ages of the various formations; suffice it to say that all are agreed in placing the interval since the beginning of the Cambrian era—when a large variety of highly organized living things already existed—at a figure which can be measured by the tens of millions of years at the very least. The only question still under debate is whether such an estimate is not too short. Certain facts regarding the accumulation of helium in minerals containing uranium—which produces helium by a very slow radioactive process—indicate that the age of the older sedimentary rocks is a thousand million years or more. If we say roughly that the time during which life has existed on the earth is probably at least a hundred million years, and perhaps a thousand million, we shall be not far from expressing the state of scientific opinion.

Now it is morally certain that, during all this enormous interval, the Sun has never been, even for a few years, very much hotter or colder than it is now. If its radiation of heat had been but half as great as at present, the whole surface of the Earth would have been ice-bound. If the Sun had been three or four times as hot and bright as it is now, the oceans, rivers and rain would all have been nearly if not quite at the boiling point. Either of these catastrophes would have put an end to the orderly development of life, and neither is consistent with the geological evidence. Indeed, a range of solar radiation from two-thirds to twice its present intensity seems to be about the utmost that can be admitted, and this corresponds to a change of hardly more than one magnitude in brightness, while the differences in brightness among the visible stars of the sidereal system amount to fully twenty magnitudes. It looks, therefore, as though not merely 2,000 years, but the whole of geological time, were but a short interval in the history of the Sun.

The Origin of the Stars

Further argument in favor of this view is found in the well known planetesimal hypothesis of Chamberlin and Moulton—according to which the solar system originated by the eruption of hot masses of material from the Sun under the influence of the attraction of some other star which passed so close to it as barely to miss hitting it. On this hypothesis, which is supported by many lines of reasoning, the orbits of the planets were originally of considerable eccentricity, and have attained their present nearly circular form by the action of the resistance due to the swarm of small particles diffused about the Sun. Mr. Jeffreys, an English astronomer, has recently calculated that, upon plausible assumptions, the time which might be required to round up the planetary orbits in this fashion should be something like three thousand million years. This fits in very well with the longest estimates of geological time; but it also indicates that the sun was a "going concern" 3,000,000,000 years ago, and must therefore, be older than this by a wide margin.

If the ages of the stars are of at all this order of magnitude, what hope have we that the slightest change in the condition of any one of them can be detected in our ephemeral lives? Little indeed, one might answer; but the problem is really not quite so bad as that.

Recent researches—largely by Eddington and the present writer—make it probable that a star starts its life as a huge body of highly rarified and relatively cool gas. As it contracts it becomes hotter and hotter, until at last it gets so dense at the center that it can no longer contract freely. Then its temperature has attained a maximum, and it begins to cool off, and finally, after the lapse of ages, goes out. The Sun appears to be in early middle age—well past the maximum of temperature, but with still a long life of moderate activity before it. But there are many stars—such as Arcturus and Antares—which present the evidences of youth. They have not yet risen to their greatest temperature, but are already very bright, because they are of such large diameter. Such stars must live their lives at a very much faster rate than the staid old Sun, and the rate at which they are shrinking should be rapid indeed. Even so, it would be hopeless to attempt to detect its effects, except in one special class of stars.

What the Figures Say

These are the Cepheid variables—stars of great brightness, and evidently at an early evolutionary stage—which probably owe their variation to periodic vibrations of some sort affecting the main mass of the star. Now if this is true, the period of the vibrations should depend upon the density of the star. For an increase in density of 2 per cent, the period should shorten by 1 per cent. Some of these stars have been observed carefully for more than a century, and in one case at least—the typical star Delta Cephei—there is evidence that the period of variation, which is rather more than five days, is actually growing shorter at the rate of one-twentieth of a second per year; that is, by one nine-millionth part of itself every year. This indicates that it would take the star about forty-five thousand years to increase in density by one per cent, and 3,000,000 years to double its density. To pass from one to another of the stages of temperature which are represented by the Harvard spectral classes probably requires, in the case of giant stars like these, something like a tenfold increase of density, which would call for some ten million years.

This estimate, which is due to Eddington, is of great interest as the first piece of direct evidence, derived from the study of the stars themselves, and bearing on this great problem of their ages. It is admittedly very rough at present; but when more such stars have been studied, and if their periods are found likewise to be shortening, it may be possible to get a very fair idea of how fast a giant star lives through its early stages.

To go from the condition of a red star like Antares or Betelguese to that of a very white one like those in the head of Scorpio or the belt of Orion involves passing over five successive steps, on the Harvard scale of the magnitudes just referred to. This would probably take more than fifty million years, for the changes would go on more slowly as the maximum temperature was approached. The later stages of a star's life, while it is cooling off, must last very much longer, for it is losing far less heat per year, and there is a huge store of heat accumulated in the interior, which must come out and be radiated from the surface before the star ceases shining.

From such evidence as we now possess, therefore, it would seem that such great stars as those of Orion's belt have already been shining for many millions of years—perhaps for a hundred millions or more—while their future duration as light givers before they finally cool off to the point of extinction is likely to run into the thousands of millions of years.

At 11 o'clock: Feb. 6
At 10½ o'clock: Feb. 14
At 10 o'clock: Feb. 21

At 9 o'clock: Mar. 7
At 8½ o'clock: Mar. 15
At 8 o'clock: Mar. 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

The Heavens

The finest region of the sky is now in the southwest, where Orion hangs resplendent, guarded by Taurus on the right and Canis Major on the left, with Canis Minor, Gemini and Auriga above. Jupiter, which is in Gemini, and at our hour of observation very high in the sky, adds to the brilliancy of the scene.

The most conspicuous constellation in the eastern sky is Leo, which also gains by the presence of a planet—in this case Saturn. Hydra rears far up from the southeastern horizon, while Virgo and Boötes are rising in the east. The Great Bear is high in the northeast, Draco and Ursa Minor are east of north, with Cassiopeia and Cepheus in the north and northwest. Perseus, Andromeda and Aries—the last two low in the northwest—complete the tale of the prominent constellations.

The Planets

Mercury is a morning star until the 23d, and an evening star after that date, but is so far south and so near the Sun that he is practically invisible all through the month.

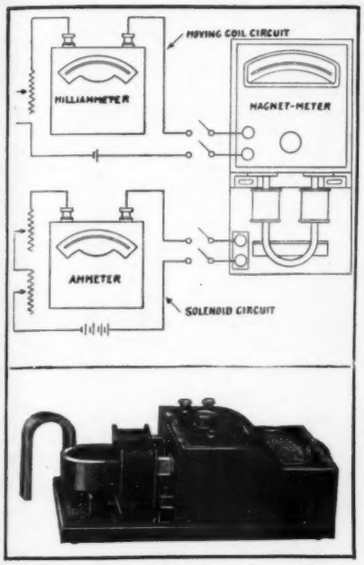
Venus is an evening star, and is now drawing out from the twilight and coming farther north, so that she is getting to be a conspicuous object. At the beginning of the month she sets at 6.25 P. M., but at its close she remains in sight until 7.40. She is actually about three times as bright as Jupiter, but will hardly look so, being much lower in the sky and on a brighter background. Telescopically she shows a small and almost circular disk, 11 seconds of arc in diameter.

Mars too, is an evening star and is in the neighborhood of Venus, but is only about one one-hundredth as bright. Even so, he much outshines any fixed star in the neighborhood, which is rather a dull region.

(Continued on page 106)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



A meter which determines the qualities of permanent magnets

An Instrument which Decides the Magnetic Qualities of Magnets

THE wide use of permanent magnets for many purposes, and especially in connection with magneto construction, has created a need for a precise and dependable instrument which will permit of their test in the finished condition. While the properties of permanent magnet material can be determined with high accuracy with a permeater, such apparatus is not designed for and cannot be satisfactorily employed in determining whether or not magnetized shapes satisfy definite requirements or specifications.

An instrument designed for testing permanent magnets should be capable of satisfactorily measuring two distinct properties. First and foremost, there is the *flux* (induction) which determines the initial strength of the magnet. This flux depends upon the degree to which the magnet has been magnetized, the efficiency of the magnetizing process, the nature and treatment of the steel used and the shape of the magnet. The second property is the *stability* (coercive force), or power to retain the flux under adverse conditions usually encountered in the use of the magnet. The stability depends, as before, upon the degree and efficiency of magnetization and the nature and treatment of the steel used.

A high initial flux will not be obtained in the use of poor material or under inefficient magnetizing conditions. But even a high initial flux has little to recommend it if the material employed has not the capability of resisting to a high degree the deteriorating influences of vibration, changes of temperature, and the possible harmful effects of other magnets with which it may be assembled. A stability measurement determines the properties in this respect.

An instrument has recently been evolved to facilitate the inspection and test of shaped permanent magnets, by serving for comparative measurements of flux and stability. It is also well adapted for determining, by means of flux tests carried out at intervals, whether magnets are properly aged. Such a test is particularly demanded where magnets are intended for use in connection with the construction of electrical measuring instruments.

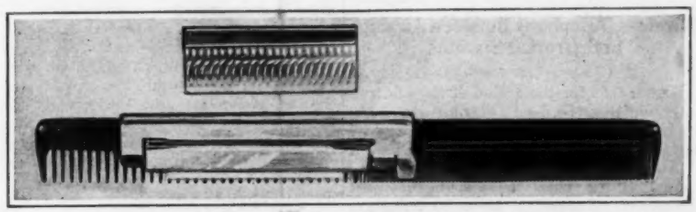
The basis of construction of this new meter and the principle of operation will be clear from the following: A coil capable of rotary movement, to which is attached a pointer traversing a calibrated scale, is supported between two specially shaped pole pieces. This movable system and scale are enclosed in an airtight housing. The pole pieces are extended through the housing into contact faces or plates, to which the polar portions of the magnet under test are applied. When a definite current is allowed to flow in the moving coil, a deflection of the pointer occurs which is proportional to the flux in the magnet applied to the contact faces.

In measuring the magnetic stability of the magnet, two adjustable solenoids are employed which are located in front of the contact faces so as to encircle the

(*Continued on page 107*)

Trimming One's Own Hair by Combing It

WITH the extensive introduction of the safety razor, the barber lost a good part of his former clientele. And now with the gradual introduction of a simple hair-trimming device which appears to complement the safety razor in a most efficient way, the barber is confronted with a further curtailing of his trade. Indeed, it is now possible for anyone to be his own barber.



Anyone can trim his own hair by means of this simple device, which employs blades of the type shown

The new hair-trimming device is nothing more than a plain comb, fitted with an attachment that holds two special steel blades similar to those used with safety razors. The blades, as will be noted in the accompanying illustration, are held so that the cutting edges are the proper distance in from the tips of the comb's teeth. In no way is it possible for the user to become cut while the device is being employed in the regular manner. The blade holder may be used over any part of the comb, with the fine teeth or the coarse teeth, according to the wishes of the user.

To trim one's hair with the new device it is only necessary to comb it. About the neck and the ears, where the hair is to be trimmed quite close, the comb is held flatly against the head, while for slight trimming the cutting edges are held farther away. It is claimed that with a little practice anyone can master the tonsorial art with this new device, thus realizing not only a considerable saving in the course of a year, but succeeding at all times in keeping the hair trimmed to the proper length.

A Fountain Which Uses an Electric Lamp for the Pump

NOTHING could be simpler than the electric fountain depicted in the accompanying illustration. This device has been recently patented by Matt Luckiesh of Cleveland, who is a well-known physicist and a contributor to these columns.

It will be noted that this simple fountain makes use of a 150-watt high efficiency electric lamp, placed in the upper part of an airtight vessel partly filled with water, and having an outlet tube connecting its lower portion with a nozzle of capillary dimensions. The expansion of the air above the water, due to the heat given out by the lamp, forces the latter out through this nozzle and the spray is caught and overflows into an outer vessel. When the current is turned off, the air pressure falls and the water returns to the inner vessel through a check valve at the bottom, as shown in the sketch.

A phonograph sound-box of odd construction, which makes use of highly stretched silk for the diaphragm

A 150-watt tungsten lamp does the pumping for this fountain

A Phonograph Sound-Box with a Silk Diaphragm

THERE has been no end to the various kinds of materials employed in phonograph reproducers or sound-boxes. Paper, hard fiber, hard rubber or ebonite, celluloid, ivory, mica—all these and many others have been tried out in the quest for better tonal qualities. The choice seems to have momentarily rested on either mica or fiber, although it is a question whether a recently-invented sound-box, which employs silk for its diaphragm, does not possess considerable merit.

It has remained for Donald M. Bliss of West Orange, N. J., to patent a phonograph sound-box which makes use of taut silk as the diaphragm. Any thin woven fabric may be used in place of silk. The fabric is stretched nearly to its elastic limit, the predetermined tension to which this member is subjected being evidenced by the fact that the same has a predetermined tone or pitch when vibrated. A stiffening disk of less diameter than the supporting member is secured to the latter, this disk having a comparatively large central opening in alinement with the neck of the reproducer. This disk is preferably formed of cellular material, such as compressed paper, and is relatively stiff. A thin disk of high density, relative to that of the stiffening disk, is secured to the diaphragm to cover the central opening, this central disk being preferably cupped or concave, and attached to the stylus arm.

Briefly, the idea of this sound box diaphragm, according to its inventor, is to have the overtones and the higher frequency vibrations well reproduced by the thin central member of high density, these vibrations not being distributed to any considerable extent in the mass of the larger member to which the thin dense disk is secured. At the same time, the size and inertia of the main portion of the diaphragm results in the faithful reproduction of tones of lower pitch in proper balance. The inventor also claims that the "scratch" is largely suppressed by his sound box. As a matter of actual test, the reproducer in question gives wonderful tones on certain records.

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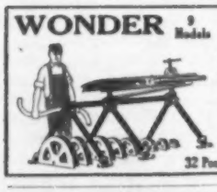

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The Current Supplement

THE valuable paper on *The Rôle of Selection in Evolution* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2248 for February 1st, 1919, deals with some of the widely divergent views held by investigators of organic evolution, and the discussion will be of great interest to students of this important subject. Food problems promise to be of vital significance to the greater part of the inhabitants of the world for a long time to come, and it behooves everyone to devote more attention to them than has ever before been considered necessary. In this connection the study of new kinds of food materials is of great importance with a view to lightening the demand for the limited number of foods that most of us have considered essential. The world contains many materials that are now but slightly utilized, or only locally, which could easily be made to add to our supplies and diversify our rather narrow bill of fare to general advantage. An article in this issue of the SUPPLEMENT on *The Palate of the Civilized World* deals with this subject, and describes a number of new foods almost unknown in this country, and several of them are shown in accompanying illustrations. It is of unusual value and interest to everyone. *An Electro-Magnetic Alternating Current Rectifier* gives very complete instructions, with working drawings, that will enable any amateur mechanic to make this useful piece of electrical apparatus. *The Production of Copper* gives a brief account of how this indispensable metal is reduced from its ores, and is accompanied by a number of excellent photographs. Other articles of value in this issue include *Electrical Welding in Shipbuilding, A Wax Medium Process for Permanent Coloring of Photographs, Resistance of Ships, Undamped Currents in "Super-Conductors"* and *The Constitution of the Earth's Interior.*

Wireless Telephony Between Airships and Ground Stations

(Continued from page 95)

pliotron. As for the action of the pliotron in converting the direct current into high-frequency undamped waves, space does not permit of a lengthy explanation.

An ordinary transmitter is employed in connection with the sending set just described. Ranges of 25 or 30 miles are readily obtained between airships and ground stations. For greater ranges the transmitting set can be used to send out undamped wireless telegraph signals, by means of the regular telegraph key. The receiving of the telephone messages is effected by means of a compact receiving set, which also employs vacuum bulbs for detecting and amplifying the intercepted waves. Instead of the usual head receivers, a loud-speaking telephone can be used so that the messages can be clearly heard throughout a large room.

The transmitting apparatus used by the Navy is of the most rugged character, to withstand rough handling and the intense vibration aboard airplanes and dirigibles alike. The pliotrons are protected against vibration by ingenious systems of spring suspension or by soft rubber pads.

Battery Versus Magneto on the Airplane

(Continued from page 96)

no magneto existed that would fire all the cylinders at the irregular angle and with the unusual timing. No such engine had ever been shown, so naturally no magneto to fire it had been designed. The best the experimenters could do for the moment was to make their tests with a group of four magnetos. But when they went on to conclude that "it proved impossible to design a single magneto that would operate with the irregular timing involved," they put a word in the magneto-maker's vocabulary that never grew there; for three weeks after they had complete data on the Liberty engine, the rotary-pole engineers had built a magneto that would fire it.

It is not clear just what steps the Liberty designers took to see whether a magneto could be designed for them. They did *not* consult the rotary-pole makers; so here at least they did not avail themselves of the best advice. It seems safe to concede that an armature magneto could not be made to fire the Liberty; so assuming that the rotary-pole was ignored, the use of the word "impossible" can be explained. But it can never be justified. In 1917 the rotary-pole was no freak or novelty; it was on a firmer basis than when the Allies began its use in 1915. There could be no excuse for not considering it, or, in considering it, for not realizing that its flexibility made feasible its adaptation to any motor in the world.

The magneto makers feel that in the matter of Liberty ignition they have been lynched. They feel they were given no chance to show that the magneto could be made to fire the Liberty; and that on the basis of the adoption of the battery—a departure that must excite universal comment—the impression has been created that something must be wrong with the magneto. This, of course, is not the case.

The Status of the Magneto

The only thing that the Liberty proves is that a plane can be fired by a battery. Magneto makers would have conceded this; they will never admit that there is any solid reason for wanting to fire a plane with a battery. Had the aircraft situation been so desperate that the three weeks delay involved in asking for a magneto and getting it would have been fatal, they would concede that the use, as an expedient, of the battery which was all ready and worked out, would have been justified. But the wholesale changes and revisions made in the motor, even after construction was begun, negative such a suggestion. These changes, magneto makers feel, make it clear that they were not given the same opportunity to adapt their product to the engine that was extended to others. They insist that in the light of these sweeping changes, failure to make one more change and substitute the magneto for the battery, once the former was shown to be applicable, is difficult to explain.

The magneto is doing business at the old stand. All non-experimental planes that do not mount the Liberty are fired by magnetos. Trucks and tanks and all the other machinery of combat and mobilization and demobilization mount magnetos by the thousands. The rotary-pole magneto cannot be made, in its own factory, in sufficient numbers to meet the demand of the Government and of private users—although that factory has been expanded repeatedly. Its makers have had to license its manufacture by others.

We can do no better, by way of clinching the magneto's position, than describe the standardized equipment recently designed by this house. We need not here dilate on the advantages of standardization and interchangeability; they are known. But the man who undertakes the standardization of magnetos is faced with the fact that different numbers of cylinders and different angles and different timing lead to vastly different magneto requirements. Nevertheless, the chief engineer of the rotary-pole magneto set to work on the scheme for a universal magneto, applicable to any engine.

How did he do it? Why, it was easy—after he had shown how it was to be done. The magnets are the same, always. All we then need do is classify all engines according to their demands, and build our magnetos in such a way that their parts may be removed and replaced by others. Take out the 2-to-1 gear and substitute a 3-to-1 or a 4-to-1 or an 8-to-3, take out the four-lobe rotor and substitute a six-lobe rotor with its modified field structure, take out the cam and substitute another with its points differently arranged; in each case the magneto will fire differently—provided, of course, we substitute a new distributing block so that it will be able to fire at all.

This, then, is the big idea. You buy a magneto, all set up to fire an eight-cylinder engine. You get with it 16 spare parts—six distributing blocks, each different from the one in the machine and from other other, three sets of substitute gears, four substitute cams, a substitute distributor, the substitute six-lobe rotor, the substitute field structure that goes with it. Any one of these parts can be put in the assembly, in the place of the corresponding part found there, with no mechanical difficulty, and with the simple tools provided with the outfit. So if you want to shift your magneto from the eight-cylinder engine for which it was bought to a 16-cylinder, 45-degree, V-type engine, all you have to do is to look at the chart provided to tell you what parts to remove and what ones to put in their places. Having substituted the proper distributing block, gears, cam, brush, rotor and field structure, the thing is done; you put the same old magneto on the new engine and it fires it.

Airship Versus Airplane

(Continued from page 99)

This requirement is much easier to fulfill on airships than on airplanes. Not only is the question of weight of minor importance on airships; the whole architecture of these craft is more adaptable to comfort than even the large airplane. It is obvious that a hull some 700 feet in length affords a splendid opportunity for fitting cabins, dining rooms, lounges, etc., at such a distance from the propelling apparatus as to virtually suppress in the living quarters any noise caused by engines and airscrews; furthermore, the engines may be effectually silenced, and, as the number of exposed wires is almost nil on rigid airships, the monotonous whistling of the wind due to the vibration of wire stays—so notable on fast airplanes—is also done away with.

Then there is the possibility of having a spacious promenade deck atop of the hull, which should prove a great inducement for long distance trips. All this installation is difficult to conceive on airplanes, where noise, vibration and restricted space are prominent features.

Prime Cost and Man-Power

Prime cost of aircraft is an item difficult, if not impossible, to estimate in the light of our present knowledge—for lack of data based on experience. Tentative figures on the prime cost of commercially adaptable aircraft have been worked out by the British Committee on Civil Aerial Transport as follows:

	Cost per lb. of gross weight	Cost per lb. of useful load
Airplane (high speed)...	18s.	40s.
Airplane (low speed)....	18s.	30s.
Airship (rigid).....	9s.	18s.

As to the man-power required for operating airships and airplanes, respectively, figures published by the British Air Ministry indicate that airships are more economical in man-power than heavier-than-air craft. These figures show that airships employed 1.62 men per hour flown, as against 3.52 for airplanes and seaplanes, and flew 1.04 hours per man employed as against 0.40 for airplanes and seaplanes.

Conclusion

It may be said in conclusion that for commercial purposes the airship is superior to the airplane in the matter of security, reliability of the power plant, loading efficiency, comfort, prime cost per pound of load carried, and man-power required for operation. It is inferior to the airplane only with respect to speed.

Should then a mere consideration of speed be allowed to retard the advent of the transatlantic and cross-continental airship, considering that it would afford maximum safety to aerial travelers at a rate of speed entirely sufficient for competing on long distances with existing means of transport?

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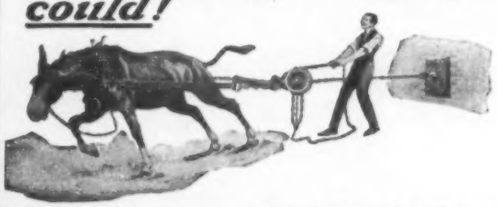

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Harnessing Boy-Power

(*Continued from page 101*)

service. And yet consider what that five per cent did for the Government in the conduct of the war!

Mr. George W. Edwards of the United States Employment Service stated in a recent newspaper article that "Boys are everywhere leaving the classrooms for the factories and shops, so that school attendance is being seriously affected. In one large eastern state the loss for the last two years is 18 per cent from the enrollment to be expected in normal times. When these boys enter war industries most of them work as messengers, water carriers, or helpers. Because they are receiving big pay envelopes they have little inclination to enter as learners in skilled employment which offers a lower initial wage. If left unchecked, these social tendencies would develop a large untrained and unskilled population. This would prove a serious handicap in the reconstruction period which must follow the war when the nation will need increased production and efficiency to restore the depleted supply of economic good."

In view of such a serious statement by such an authority, the program of the Boy Scouts of America becomes of vital importance to the nation. It is a program of preparedness in the duties of citizenship. "Be Prepared" is the slogan of the Boy Scouts. This country has never witnessed such a spectacle as the mobilization for national service of nearly 400,000 uniformed boys, who proved themselves prepared to perform difficult tasks efficiently. It is not so much the mobilization of these same boys for similar tasks in the period of reconstruction, that makes the program invaluable. But rather, the contribution that scout trained boys individually will make to every line of industry and in every profession, when they enter upon the duties of manhood.

Man-leadership is the key to the success of this great movement. Nearly 30,000 scoutmasters and assistant scoutmasters are directing the work of these 335,000 boys. "Plain American men," these scoutmasters. Fellows of unassailable character, big of heart, believers in boyhood, willing to learn the scouting program, willing to give of their time and strength to a big task like this. As a matter of fact, most of them get as much out of the program as the boys do, for no man ever loses his boyhood. It may have gone sound asleep, but it is inside him yet. And the minute he hears in his inner voice the call of scouting, BANG! there is his boyhood out of bed and the scout uniform half on.

It is the simplest proposition imaginable to harness the boy-power of the nation. And yet it is a far greater, more important proposition than harnessing the water power of the nation. And it is just as easy to spot the waste of boy-power in your town, as to point to the waste of power in a racing stream. And the problem is a community problem. Harnessing the boy-power by means of the Boy Scout program, calls for community interest in the boys. In view of what can be done, it would seem as though no man could rest content until he had done his part toward conserving, harnessing, storing up the boy-power of his town for the boy himself and for his town and for his country.

The Heavens in February, 1919

(*Continued from page 102*)

On the 13th Mars and Venus are in conjunction, the brighter planet being a little more than half a degree south of the other. Both are moving eastward, but Venus is gaining on Mars by nearly half a degree per day, so that she appears lower in the sky than Mars before the 13th, and higher after that date. This conjunction will be easily observable, just after dark, and will be well worth looking for.

Jupiter is in Gemini, past opposition, but splendidly visible all night, being high

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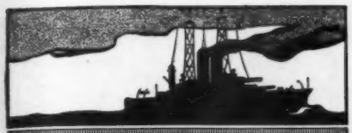

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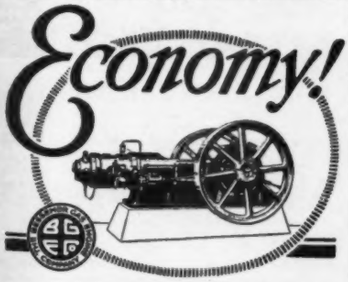
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in the east at sunset, and crossing the meridian at 9 P. M. in the middle of the month. His satellites present an interesting telescopic spectacle, especially on the early morning of the 12th when the first of them is in front of the planet, and the second and third behind it or in its shadow.

Saturn is in opposition on the 14th and is visible all night long. He is in Leo, and considerably outshines its brightest star, Regulus. With the telescope it becomes evident that his rings are seen much more nearly edgewise than a few years ago, for the poles of the planet project far beyond them.

Uranus is in conjunction with the Sun on the 17th, and is invisible this month. Neptune is just past opposition, and may be observed with the telescope, his position on the 2d being R. A. 8h. 40m. 48s. Declination 18° 14′ North; and on March 2d, 8h. 37m. 58s., 18° 25′ North.

The Moon is in her first quarter at 2 P. M. on the 7th, full at 7 P. M. on the 14th, in her last quarter at 9 P. M. on the 22d. There is no new moon this month, the previous conjunction with the sun having fallen at 9 P. M. on January 31st, while the next is not due until 6 A. M. on March 2d. This rather unusual occurrence can only take place in February, the other months being longer than the moon's synodic period.

The Moon is nearest the Earth on the 4th, and farthest away on the 20th. She is in conjunction with Uranus, Venus and Mars on the 2d, Jupiter on the 11th, Neptune on the 13th and Saturn on the 14th, none of the observable conjunctions being close.

Washington, D. C.
January 20th, 1919.

An Instrument which Decides the Magnetic Qualities of Magnets

(Continued from page 103)

respective legs of the test magnet. If current is allowed to flow in the proper direction through the windings of these solenoids when the pointer is deflected in reading the flux, the deflection may be reduced to zero by regulation of the current. The value of this current is a direct measure of the stability of the magnet.

The measurement of flux does not affect the magnetization, and the state of the magnet remains unchanged. The measurement of stability, as will be seen, involves a demagnetization operation, and the magnet must be remagnetized after such a test. In practice, therefore, the flux test may be carried out on every magnet in a lot, while it may be found advisable, except in special cases or in investigative work, to test for stability a few magnets selected as samples from the lot.

The design of the meter is such that the pointer moves at all times to its deflection value or back to zero without oscillating through its final position. In other words, the damping of the instrument is entirely independent of the flux of the magnet under test. The scale is provided with a parallax mirror and is 5¾ inches in length, being uniformly graduated into 180 divisions or 18 grand divisions. These grand divisions are marked so as to provide a scale reading 3-0-15. Means are provided for setting the pointer on zero.

The support of the moving coil is provided by metal upper and lower suspensions which are in tension. This furnishes a movement of great sensitivity while rendering unnecessary the leveling of the instrument. The special construction and robust character of these suspensions makes their breakage practically impossible even under the most careless handling of the instrument.

The instrument is rapid working and reliable. The design entirely eliminates the residual effects which might affect readings, due to weak magnets following strong ones in the course of routine tests. The current in the moving coil circuit is supplied from a dry cell, while the current

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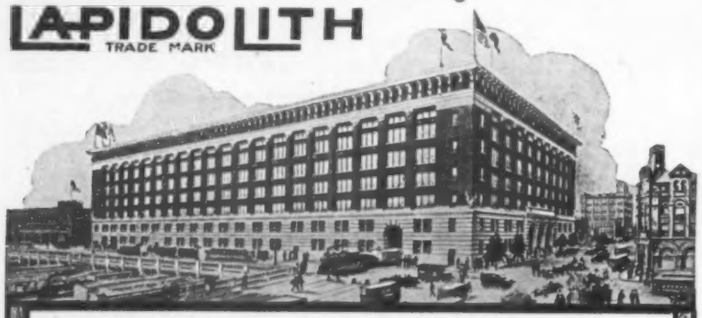

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in the solenoid circuit is from a 6- to 8-volt storage battery. Contact shoes are provided to permit of ample contact between the polar portions of the test magnet and the contact plates, in cases where the ends of the magnet are not finished.

The Paravane

(Continued from page 91)

The paravane has its limitations, to be sure. There is involved the element of chance as in many other phases of warfare. If the ship equipped with paravanes strikes a mine nose on, nothing can save it from a smashed bow, which entails the flooding of only a small portion of the ship. But if it passes a mine but a few feet to one side, the paravanes take care of that mine in an efficacious manner. It is stated that the British fleet assigned to visit the German ports following the signing of the armistice, traversed the German mine fields without an untoward incident, thanks to their paravanes.

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Good Brick from Slags

WHILE excellent paving brick is being made from English blast furnace slags, an equivalent product has not yet been made in the United States.

British practice consists in pouring molten slag into split metal molds, removing the red hot bricks when they have solidified sufficiently to be handled without deformation, and placing them into kilns where they cool and anneal slowly.

These bricks have a "stony" texture, while American bricks made in a similar manner are glassy and brittle. Composition of the slag probably has a great deal to do with these conditions, the British slag containing 26 per cent silica and 22 per cent alumina, while here the corresponding amounts are 34 and 14. In practice, American slags quickly solidify with a thin, tender skin, retaining a molten interior for a considerable period. To make successful brick the author specifies that the hot mass must be immersed in red hot sand, or some other hot medium which effectually excludes air and furnace gases, in such a manner that the heat from the packing and the molten interior reheats the chilled shell into a very viscous substance. Further cooling must now be arranged so that the exterior and interior of the mass shall cool at about the same rate, from 12 to 18 hours being required.

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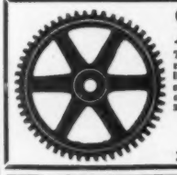

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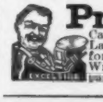

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